10. AIR QUALITY

10.1 Introduction

The Proposed Development incorporates the construction and operation of a hydrodynamic research facility to replace existing facilities within the AWE Aldermaston Site. The Hydrus Facility will be in use throughout the year and will generally operate during normal working hours, although occasional operation outside normal working hours may be necessary.

This chapter assesses the air quality impacts associated with the Proposed Development due to vehicle related emissions during the peak year of construction (2014) and stack emissions from the rapid ventilation system associated with the experiments.

The proposed Hydrus Facility will typically be used to conduct 10 experiments (also termed firings). It should be noted that the number of experiments will be lower than conducted in the existing facility due to the enhanced diagnostics capability. A typical sequence of events during each experiment will include:

- A rapid ventilation system operated either during or following an experiment for a period of 1 hour; and
- An experiment / firing comprising detonation of conventional explosives within the hardened structure, simultaneously with X-ray generators (comprising high voltage impulse generator/inductive voltage adder).

Two types of firings will be undertaken at the proposed Hydrus Facility, to provide varying levels of diagnostic information, these are;

- Open Firings: An experiment conducted within a hardened structure which provides safety and waste management control of materials; and
- Contained / Closed Firings: An experiment conducted within a containment vessel located within the hardened structure which provides additional safety and waste management control of hazardous and radioactive materials.

Both the open and contained firing experiments are then vented via a rapid ventilation stack. Emission controls have been designed inline with "As Low As Reasonably Practicable" (ALARP) and Best Practicable Means (BPM).

There are other protrusions on the roof of the Operations Building other than the stack associated with the rapid ventilation system. These are shown in the Figure 5-1 Application Master Plan in Chapter 5 of this DEEA, and include two fume cupboard stacks, ten roof ventilators associated with the building ventilation system and eighteen smoke ventilators which are part of a smoke control system for the Hydrus Facility and will only operate in the event of a fire in the building. There is also an additional fume cupboard stack on the Support Building.

Emissions have been assessed in the first operational year of the Hydrus Facility (2016). The proposed Hydrus Facility will replace the existing facility so there will be no net increase in emissions from hydrodynamics experiments.

The policy context and legislation for undertaking air quality assessments together with the methods and assessment criteria used to assess the potential air quality effects are described. A review of existing air quality monitoring in the local vicinity of AWE Aldermaston Site has been conducted to establish the typical baseline air quality. The predicted impacts arising from the construction and the completed development are addressed, with appropriate mitigation measures proposed, to prevent, reduce or offset the impacts. Where residual impacts (impacts after the implementation of mitigation measures) arise, the significance of these impacts is described in relation to significance criteria adopted from the National Society for Clean Air (NSCA) guidance (the NSCA has been renamed Environmental Protection UK (EPUK) since the guidance was published). There will be no permanent increases in road traffic due to the Proposed Development; therefore, road traffic has only been assessed for the construction phase of Proposed Development. Any limitations, constraints and assumptions relating to the assessment are described in the relevant section.

This chapter has been prepared by RPS Group using data provided by AWE.

10.2 Legislation and Planning Policy Context

10.2.1 European Legislation

The European Union Framework Directive 1996/62/EC (Ref. 10-1) on ambient air quality assessment and management came into force in November 1996 and had to be implemented by Member States, including the UK, by May 1998. The Directive aims to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants. As a Framework Directive it requires the Commission to propose and set "Daughter" Directives prescribing air quality limit values and alert thresholds together with guidance on monitoring and measurement of individual pollutants.

A new EU Directive 2008/50/EC (Ref. 10-2), replacing 1996/62/EC and three of the four Daughter Directives, is to be implemented by Member States by June 2010. In some cases the Directive establishes a two stage approach to setting limit values. A lower limit value applies at Stage 2, which must be achieved by all member states, with a requirement for them to demonstrate progress towards meeting the upper limit value over time. The new Directive makes provision for the:

- Withdrawal of the Stage 2 2010 PM_{10} indicative limit values and the opportunity to apply for an extension to the existing target dates for achievement of the limit values;
- Introduction of a 'national exposure reduction target' to the average of annual-mean $PM_{2.5}$ concentrations measured at urban background locations throughout the territory of a Member State by up to 20% between 2010 and 2020 with the actual reduction dependent on the initial concentration;
- Introduction of an 'exposure concentration obligation' based on the average of annual-mean $PM_{2.5}$ concentrations measured at urban background locations throughout the territory of a Member State of 20 $\mu g.m^{-3}$ to be met by 2015;
- Introduction of a target value for annual-mean $PM_{2.5}$ of 25 $\mu g.m^{-3}$ to be met by 1 January 2010; and
- Introduction of a Stage 1 limit value for annual-mean $PM_{2.5}$ of 25 $\mu g.m^{-3}$ to be met by 1 January 2015 and an indicative Stage 2 limit value of 20 $\mu g.m^{-3}$ to be met 1 January 2020.

10.2.2 National Legislation and Policy

10.2.2.1 Air Quality Standards Regulations

The Air Quality Standards Regulations 2007 (Ref. 10-3) implement limit values prescribed by the EU Directive 1996/62/EC and the relevant Daughter Directives within England. The limit values are legally binding and the Secretary of State, on behalf of the UK Government, is responsible for their implementation.

10.2.2.2 UK Air Quality Strategy

The current UK Air Quality Strategy (AQS) (Ref. 10-4) was published in July 2007 and updates the original strategy published in 2000 (Ref. 10-5) and its addendum (Ref. 10-6) published in 2003. The objectives are statements of policy intentions made by the UK Government and its Devolved Administrations. The AQS objectives are based on the evidence supporting the identification of the limit values and, in some instances, are more onerous than the requirements established by the limit values set out in the Air Quality Standards Regulations 2007.

Under the AQS, local authorities have a duty to review and assess local air quality within their administrative area. The Review & Assessment (R&A) process requires local authorities to undertake a phased assessment to identify any areas likely to experience exceedences of the air quality objectives. Any location likely to exceed the objectives must be designated an Air Quality Management Area (AQMA) and an Air Quality Action Plan (AQAP) must be prepared and implemented, with the aim of achieving the objectives in the designated area.

For the purposes of this assessment, the limit values set out in the Air Quality Standards Regulations 2007 and the objective levels specified under the current UK AQS have been used and are summarised in Table 10-1.

Table 10-1: Summary of Relevant Air Quality Strategy Objectives and Limit Values

Pollutant	Averaging Period	Objectives/ Limit Values	Not to be Exceeded More Than	Target Date
Nitrogen dioxide (NO_2)	1 hour	200 $\mu g.m^{-3}$	18 times per calendar year	31.12.2005 [(a)]
		200 $\mu g.m^{-3}$		01.01.2010 [(b)]
	Annual	40 $\mu g.m^{-3}$	-	31.12.2005 [(a)]
		40 $\mu g.m^{-3}$		01.01.2010 [(b)]
Particulate matter (PM_{10})	24 hour	50 $\mu g.m^{-3}$	35 times per calendar year	31.12.2004 [(a)]
		50 $\mu g.m^{-3}$		01.01.2005 [(b)]
	Annual	40 $\mu g.m^{-3}$	-	31.12.2004 [(a)]
		40 $\mu g.m^{-3}$		01.01.2005 [(b)]
Particulate mater ($PM_{2.5}$)	Annual	Target of 15% reduction in concentrations at urban background locations	-	Between 2010 and 2020 [(a)]
	Annual	25 $\mu g.m^{-3}$	-	2020 [(a)]

[(a)] Target date set in UK Air Quality Strategy 2007
[(b)] Target date set in Air Quality Standards (England) Regulations 2007

For pollutants that do not have an AQS objective or limit value prescribed under current legislation, non-statutory air quality objectives and guidelines have been applied within this assessment. The Environment Agency (EA) provides further assessment criteria in the form of Environmental Assessment Levels (EALs), which are contained in Horizontal Guidance Note EPR H1 (Ref. 10-7). Table 10-2 presents the available EALs for the pollutants relevant to this assessment. The long-term EALs refer to an annual-average period, whilst the short-term EALs are applied as 1-hour averaging periods.

Table 10-2: Environmental Assessment Levels (µg.m^{-3})

Pollutant	Long-term EAL	Short-term EAL
CO	350	10,000
HCl	20	750
HF	-	160
HCN	-	220
$COCl_2$	0.8	25
CH_3OH	2660	33300
F_2	1	2.8
CH_2O	5	100

10.2.2.3 National Planning Policy and Guidance

Policy Guidance: Local Air Quality Management LAQM.PG(09) (Ref. 10-8) was issued by the Secretary of State under Section 88(1) of the Environment Act 1995. It is designed to assist local authorities with their local air quality management duties. The guidance requires that local authorities integrate air quality considerations into the planning process at the earliest possible stage. As a result, the land use planning system is integral to improving air quality.

The guidance applies to all local authorities in England both with and without AQMAs. This common approach to air quality will provide benefits such as raising the profile of air quality in transport planning, and increasing communication across local authority departments.

Planning Policy Statement 23: Planning and Pollution Control (PPS23) (Ref. 10-9) offers guidance to local authorities on the relationship between controls over development under planning law, and under pollution control legislation.

Planning applications that are in accordance with the relevant development plan should be allowed, unless material considerations indicate otherwise. PPS23 states that any air quality consideration that relates to land use and its development is capable of being a material planning consideration. However, the weight given to air quality in deciding the application will depend on such factors as: the severity of the impacts on air quality; the air quality in the area surrounding the proposed development; the length of time people are likely to be exposed; and the positive benefits provided through other material considerations.

10.2.3 Regional and Local Planning Policy

10.2.3.1 The Regional Spatial Strategy for the South East 2006 – 2026

The South East Regional Spatial Strategy (Ref. 10-10) replaces Regional Planning Guidance for the South East (RPG9). The strategy sets out a vision and strategic planning policies for the region through to 2026, bringing together policies for development with other policies and programmes that influence the nature of places and how they function including those governing health, social issues, the economy, culture, skills and the environment.

The document specifically recognises air quality as being of regional significance and sets out the following under Policy NRM9, Air Quality:

"Strategies, plans, programmes and planning proposals should contribute to sustaining the current downward trend in air pollution in the region. This will include a seeking of improvement in air quality in their areas so that there is a significant reduction in the number of days of medium and high air pollution by 2026. Local development documents and development control can help to achieve improvements in local air quality through:

i. *Ensuring consistency with air quality management plans;*
ii. *Reducing the environmental impacts of transport and congestion management, and support the use of cleaner transport fuels;*
iii. *Mitigating the impact of development and reduce exposure to poor air quality through design, particularly for residential development in areas which already, or are likely to, exceed national air quality objectives;*
iv. *Encouraging the use of best practice during construction activities to reduce the levels;*
v. *Considering the potential impacts of new development and increased traffic levels on internationally designated nature conservation sites, and adopt mitigation measures to address these impacts".*

10.2.3.2 Strategic Guidance - Berkshire Structure Plan 2011-2016

The Berkshire Structure Plan (Ref. 10-11) was prepared by the Berkshire Unitary Authority's Joint Strategic Planning Unit and was adopted by the Secretary of State on 15th July 2005.

Policy EN5: Air Pollution and Noise states that:

"Development should not give rise, either by itself of cumulatively with other developments, to unacceptable levels of noise, smell, dust, light or noxious emissions affecting areas beyond the site boundary, or to unacceptable levels of air pollution. In addition, existing and future levels of environmental nuisance should be taken into account when the location of uses sensitive to disturbance such as new house, schools and hospitals is planned."

The Structure Plan is a document that was prepared under the old planning system. Structure Plans and Local Plans will be replaced with a new one, made up of Regional Spatial Strategies (RSSs) and Local Development Frameworks (LDFs). Until these new systems are in place, planning decisions must continue to be taken in accordance with the 'saved' policies of the Berkshire Structure Plan, unless material considerations indicate otherwise.

10.2.3.3 West Berkshire District Local Plan

West Berkshire Council (WBC) has completed the first draft of the Local Development Framework (LDF) and is currently preparing a formal response following the consultation period. As such the West Berkshire Local Plan (Ref. 10-12) is still in force. The Local Plan contains the following 'saved' policy in the 'Overall Strategy' which relates to air quality:

"POLICY OVS.5 The Council will only permit development proposals where they do not give rise to an unacceptable pollution of the environment. In order to minimise the adverse impact on the environment or loss of amenity proposals should have regard to:

- *the need to ensure the adequate storage and disposal of waste materials; and*
- *the installation of equipment to minimise the harmful effects of emissions; and*
- *locating potential nuisance or pollution activities onto the least sensitive parts of the site or where the impacts can be best contained by physical or other appropriate measures."*

It also contains a relevant 'saved' policy within the Environment section:

"POLICY ENV.30 The Council will seek to safeguard existing urban areas within West Berkshire from the effects of environmental pollution and serious loss of amenity, and where appropriate give a high priority and favourable consideration, to environmental improvements which benefit residents and other users."

10.2.3.4 Basingstoke and Deane District Local Plan

Basingstoke and Deane Borough Council (BDBC) are in the process of preparing their LDF. As such a number of policies from the Adopted Local Plan (Ref. 11-13) have been 'saved' and currently remain valid for the determination of planning applications. The Adopted Local Plan environmental strategy contains the following statement which relates to air quality:

"POLICY E1 Proposals for new development will be permitted provided that they are of a high standard of design, make efficient use of land, respect the amenities of neighbouring occupiers, and do not result in inappropriate traffic generation or compromise highway safety". The main points under policy E1 relating to this assessment includes:

- *"not generate traffic of a type or amount inappropriate for roads, properties or settlements in the locality, and provide safe and convenient access for all potential users, integrating into existing movement networks and open spaces; and*
- *minimise the potential for pollution of air and soil and not create noise or light which harms living and working conditions or the public's enjoyment of the built and natural environment."*

10.3 Assessment Methodology and Significance Criteria

10.3.1 Overview

The approach to this air quality assessment includes the key elements listed below and, where appropriate, follows UK Government guidance LAQM.TG(09):

- Consideration of both WBC and BDBC Air Quality Review and Assessment documents;

- Assessment of existing local air quality conditions through a review of available air quality monitoring data for the area;
- Qualitative assessment of the effect of dust from the construction phase on local air quality;
- Quantitative assessment of the impact on local air quality from traffic associated with the construction phase of the Proposed Development, based on forecast traffic data and utilising the Design Manual for Roads and Bridges (DMRB) screening model;
- Quantitative assessment of the impact on local air quality from stack emissions associated with the Proposed Development, based on provided emission data and utilising an advanced dispersion model;
- Significance criteria used in the assessment are set out in Table 10-6 and Table 10-7 for vehicle emissions and Table 10-13 and Table 10-14 for stack emissions; and
- Appropriate mitigation measures required to prevent, reduce or offset the effects are identified, together with the significance of residual impacts.

10.3.2 Summary of Pollutants Assessed

10.3.2.1 Vehicle Emissions

The key pollutants from road traffic associated with local air quality and health impacts are nitrogen dioxide (NO_2) and particles (comprised of fine particles up to 2.5 µm in diameter ($PM_{2.5}$) and a coarser fraction of particles between 2.5 µm and 10 µm (PM_{10}) in diameter. The fraction known as PM_{10} comprises all particles up to 10 µm in diameter and therefore includes both the fine and coarse fractions. NO_2 represents between 10 to 40% of total oxides of nitrogen (NO_x) emissions from motor vehicle exhausts collectively; the higher proportion is found in regions with a greater number of diesel vehicles and due to the use of catalytic converters (although there is some variation between different engine types and exhaust technologies). The remainder of the NOx is present as nitric oxide (NO). The NO oxidises in the atmosphere to form NO_2. NO_x can affect sensitive vegetation directly and contribute to regional acid deposition.

In addition to these pollutants, motor vehicles also emit carbon monoxide (CO), unburned hydrocarbons and various greenhouse gases including carbon dioxide (CO_2). However, the construction and operational assessment of vehicle emissions is limited to the traffic-related pollutants highlighted as a concern through local air quality review and assessment work by WBC and BDBC. These are NO_2 and PM_{10}. Additionally in recent years the $PM_{2.5}$ fraction of particulates has been highlighted as being of equal if not greater concern when considering respiratory impacts. As such a semi-quantitative assessment has been made of $PM_{2.5}$ emissions from road traffic, as detailed under the section “Fine Particulate Matter ($PM_{2.5}$) Impacts”.

10.3.2.2 Stack Emissions

During normal operations the Operations Building will discharge radionuclides to the atmosphere at a level where detection in the environment is not possible. However, as the potential for discharge exists, AWE has made provision for radionuclide discharges from the Hydrus Facility with the AWE Radioactive Substances Act 1993 (RSA93) (Ref. 10-14) authorisation. . The authorisation prescribes limits for the release of gaseous radionuclides from the AWE Site; discharges from the Hydrus Facility will be accounted for within these limits.

The Hydrus Facility will discharge radionuclides to the atmosphere via an aerial abatement system which has been designed to comply with the principles of Best Practicable Means (BPM) and ALARP. The aerial abatement design comprises of a wet scrubber system and two stages of High Efficiency Particle Attenuation (HEPA) filtration.

Non-radioactive discharges from the Hydrus Facility will be at very low levels and will not require permission under the Environmental Permitting (England and Wales) Regulations 2010 (EPR) (Ref.10-15). To ensure best practice, abatement measures have been identified based on the principles of BAT. The integrated aerial abatement system will manage both radioactive and non radioactive discharges from the Hydrus Facility.

The assessment of stack discharges has therefore been limited to those pollutants for which there exists either an Air Quality Strategy (AQS) objective or an Environmental Assessment Level (EAL) against which to assess the ground level concentration. This assessment therefore considers:

- Uranium (U-234 and U-238);
- Caesium (Cs-137), used as a surrogate for beta doses from daughters in the uranium decay chains, to ensure the potential radiological dose is assessed at the closest receptor, namely the Manor House Hotel;
- Nitrogen dioxide (NO_2);
- Carbon monoxide (CO);
- Hydrogen chloride (HCl);
- Hydrogen fluoride (HF);
- Hydrogen cyanide (HCN);
- Nitrogen (N_2);
- Phosgene ($COCl_2$);
- Methanol (CH_3OH);
- Fluoride (F_2); and
- Formaldehyde (CH_2O).

There is also the potential for emissions from the fume cupboard stacks. Fume cupboards are classed as local exhaust ventilation (LEV) equipment and are exempt from local authority and EA permitting and reporting. LEV units are unlikely to contain significant quantities of chemicals and following guidance must be filtered to remove or render substances harmless or inoffensive. On this basis, any emissions from the fume cupboard stacks are anticipated to be significantly less than from the main stacks.

10.3.3 Construction-Phase

10.3.3.1 Construction Dust Impact Assessment Methodology

The level and distribution of construction-related particulates will vary according to factors such as the type, duration and location of dust-generating activity, weather conditions and the effectiveness of dust-suppression measures.

Nuisance caused by the deposition of construction dust is likely to be the most significant issue in relation to local air quality effects during the construction phase. No statutory or official air quality criterion for dust annoyance has been set at a UK, European or World Health Organisation (WHO) level.

By convention, therefore, the assessment of construction dust is normally confined to a risk-based assessment to determine the likelihood that emissions may give rise to a significant impact. The use of a risk assessment approach to determine construction phase impacts has been endorsed by recent London Best Practice Guidance (see below), which advises that consideration should be given to the size of the construction site and location of nearby sensitive receptors. It is common practice to use a distance of 100 m as the radius within which significant effects may occur. This value stems from the UK Mineral Planning Guidance (MPG) 2, and while it is strictly related to dust generated by mineral extraction is commonly accepted for construction dust and other activities.

The London Best Practice Guide (BPG) on the control of dust and emissions from construction and demolition has been produced by the Mayor of London, in association with the Air Pollution Planning and the Local Environment (APPLE) working group, comprising participants from the Greater London Authority and the Association of London Councils (Ref. 10-16).

Emissions of nuisance dust during construction are generated by a wide of range of activities and are fugitive. Consequently, it is not possible to derive an emissions dataset to facilitate modelling. This is recognised in the widely accepted BPG, which advocates an assessment based on risk.

The BPG is designed to inform the planning process and assist developers in understanding the methods to control dust and emissions from construction and demolition activities. Although the Application Site is located outside London, the BPG represents the most comprehensive and robust guidance currently available.

Construction activities have been assessed against the overarching BPG criteria provided in Table 10-3.

Table 10-3: London Best Practice Guide Site Evaluation Guidelines

Low risk sites	Development of up to 1,000 square metres of land; and
	Development of one property and up to a maximum of ten; and
	Potential for emissions and dust to have an infrequent impact on sensitive receptors.
Medium risk sites	Development of between 1,000 and 15,000 square metres of land; and
	Development of between ten to 150 properties; and
	Potential for emissions and dust to have an intermittent or likely impact on sensitive receptors.
High risk sites	Development of over 15,000 square metres of land; or
	Development of over 150 properties; or
	Potential for emissions and dust to have significant impact on sensitive receptors

Where risks are identified, mitigation measures will be provided which are consistent with the level of risk assessed. The BPG advises that, by evaluating proposed construction and demolition activity, complaints relating to nuisance are likely to be reduced.

10.3.3.2 Construction Traffic Impact Assessment Methodology

Construction of the Proposed Development will have associated with it construction traffic, comprising contractors' vehicles and heavy duty vehicles (HDVs), diggers, and other diesel-powered vehicles. The traffic information used in the air quality assessment has been taken from *Chapter 9: Transport* and *Technical Appendix C: Transport Assessment* of this DEEA.

<u>Model Selection</u>

The Design Manual for Roads and Bridges (DMRB) (Ref. 10-17) model has been used to estimate future traffic-related pollutant concentrations from the local road network in the peak construction year (2014). The assessment utilises the DMRB version 1.03c (July 2007) which calculates pollutant concentrations based on empirical relationships between traffic density, speed and distance of sensitive locations from road networks.

Annual-mean NO_2 and PM_{10} concentrations have been predicted at the proposed sensitive receptors using the DMRB model. Annual-mean NO_2 concentrations have been derived from the modelled annual-mean NO_x concentration using the LAQM.TG(09) calculator as referred to in the Defra LAQM.TG(09) document (Ref.10-18). The assessment of $PM_{2.5}$ has been considered semi-quantitatively because the DMRB model does not predict concentrations of $PM_{2.5}$ as traffic/speed related data for emissions of this pollutant are not readily available.

<u>Modelled Scenarios</u>

Modelling has been undertaken for the following scenarios:

- 2008 Baseline: Current Baseline (2008);
- 2014 Baseline: Future Baseline Assuming no Construction Traffic 'Without Development; and
- 2014 With: Peak Year of Hydrus Construction Traffic Movements.

<u>Model Inputs: Traffic Flow Data</u>

Traffic flow data have been generated from traffic counts carried out in 2008 using Automatic Traffic Counts (ATCs) located on the A340 (Paices Hill), Red Lane, Reading Road, A340 (Aldermaston Road), Heath End Road, A340 (Milfords Hill) and Silchester Road. Twenty-four hour two-way Annual Average Daily Traffic (AADT) counts have been generated for 2008 (Base Year) 2014 and 2014 with and without the peak construction traffic.

A summary of the traffic flow data used is provided in Table 10-4.

Table 10-4: Traffic Flows used in DMRB Assessment

Road	Speeds (kph)	2008 Baseline		2014 Baseline		2014 With Construction		Percentage Change With Construction
		AADT	% HDV	AADT	% HDV	AADT	% HDV	AADT
Aldermaston Village	47.5	9,563	4.9%	11,553	5.2%	11,611	5.7%	0.5%
Paices Hill	64.5	7,994	5.2%	9,324	5.3%	9,382	5.9%	0.6%
Link Road	95.0	1,132	2.1%	1,260	2.1%	1,260	2.1%	0.0%
B3051 (east of Heath End RBT)	95.0	9,428	1.5%	10,869	1.4%	10,871	1.4%	<0.1%
Heath End Road	47.5	6,289	1.1%	7,240	1.1%	7,241	1.1%	<0.1%
A340 (south of Aldermaston Gate)	63.3	7,139	5.3%	8,433	5.1%	8,435	5.1%	<0.1%
Aldermaston Road	55.0	14,285	3.0%	16,090	3.1%	16,119	3.3%	0.2%
A340 (Mulfords Hill)	47.5	14,343	2.8%	16,813	2.9%	16,840	3.0%	0.2%
Reading Road (north of Main Gate)	72.8	6,949	2.4%	8,224	2.8%	8,226	2.8%	<0.1%
Soke Road (nr Red Ln)	79.2	1,514	1.2%	2,201	2.7%	2,201	2.7%	0.0%
Reading Road (South of Soke Rd RBT)	79.2	8,112	2.4%	10,002	3.0%	10,004	3.0%	<0.1%
Soke Road (South of RBT)	79.2	3,044	1.1%	3,746	1.8%	3,746	1.8%	0.0%
Welshmans Road	79.2	2,497	0.8%	2,832	0.8%	2,832	0.8%	0.0%
Reading Road (North of Welshmans Rd)	79.2	8,226	2.2%	9,668	2.4%	9,669	2.4%	<0.1%
Red Lane	79.2	2,884	0.6%	3,445	0.5%	3,445	0.5%	0.0%
Red Lane (North of BHG)	62.5	2,053	1.3%	2,768	2.5%	2,768	2.5%	0.0%

Notes: HDV – Heavy Duty Vehicles

<u>Model Verification</u>

LAQM.TG(09) requires that local authorities verify the results of any detailed modelling undertaken for the purposes of fulfilling their Review and Assessment (R&A) duties. Model verification refers to *"checks that are carried out on model performance at a local level"*. Modelled concentrations are compared with the results of monitoring and, where there is a disparity between modelled and monitored concentrations, an adjustment may be established and applied.

For the verification and adjustment of NO_x/NO_2 concentrations, LAQM.TG(09) recommends that the comparison involves a combination of continuous and diffusion monitoring, rather than a single continuous monitor. This is to ensure any adjustment factor derived is representative of all locations modelled and not unduly weighted towards the characteristics at a single site. Where only diffusion tubes are used for the model verification, the study should consider a broad spread of monitoring locations across the study area to provide sufficient information relating to the spatial variation in pollutant concentrations. No adjustment factor is deemed necessary where the modelled concentrations are within 25% of the monitored concentrations.

No continuous monitoring of road-related pollutants is undertaken within close proximity to the AWE Aldermaston Site and there is only one diffusion tube site in the model domain located in Aldermaston Village. A receptor has been included in the modelling at the Aldermaston Village roadside diffusion tube location so that a comparison of the predicted monitored annual-mean NO_2 concentrations can be undertaken. However, undertaking a model correction against only a single site would unduly weight the results, and, therefore, it is not possible to carry out model verification for this assessment though the predicted concentrations from the model compare favourably to the results of the Aldermaston Village roadside diffusion tube site (monitored 32 $\mu g.m^{-3}$ vs modelled 31.4 $\mu g.m^{-3}$).

<u>Short-Term Concentration Predictions</u>

NO_2 1-Hour Mean Air Quality Strategy (AQS) Objective

Research undertaken in support of LAQM.TG(09) has indicated that the hourly-mean limit value and objective for NO_2 is unlikely to be exceeded at a roadside location where the annual-mean NO_2 concentration is less than 60 $\mu g.m^{-3}$. In May 2008, a re-analysis of the relationship between annual and hourly-mean NO_2 concentrations was undertaken using data collated between 2003 and 2007 (Ref. 10-19). The conclusions and recommendations of that report are:

"Analysis shows that statistically, on the basis of the dataset available here, the chance of measuring an hourly nitrogen dioxide objective exceedence whilst reporting an annual-mean NO_2 of less than 60 $\mu g.m^{-3}$ is very low.

It is therefore recommended that local authorities continue to use the threshold of 60 $\mu g.m^{-3}$ NO_2 as the guideline for considering a likely exceedence of the hourly mean nitrogen dioxide objective."

The report recommends that this analysis is undertaken annually. However, following the current recommendation, the hourly objective is not considered further within this assessment if the annual-mean NO_2 concentration is predicted to be less than 60 $\mu g.m^{-3}$.

PM_{10} 24 Hour-Mean AQS Objective

The number of exceedences of the daily-mean AQS objective for PM_{10} of 50 $\mu g.m^{-3}$ may be estimated using the relationship set out in LAQM.TG(09):

*Number of Exceedences of Daily Mean of 50 $\mu g.m^{-3}$ = (-18.5 + 0.00145) * (Predicted Annual-mean PM_{10})^3 + 206 / (Predicted Annual-mean PM_{10} Concentration)*

This relationship suggests that the daily-mean AQS objective for PM_{10} is likely to be met if the predicted annual-mean PM_{10} concentration is 31.8 $\mu g.m^{-3}$ or less. The Air Quality Strategy Volume 2 (Ref. 10-20) Evidence Base states, throughout the document, that an annual-mean PM_{10} concentration of 31.5 $\mu g.m^{-3}$ is approximately equivalent to the daily-mean objective.

To adopt the most conservative approach, the daily mean objective is not considered further within this assessment if the annual-mean PM_{10} concentration is predicted to be less than 31.5 $\mu g.m^{-3}$.

<u>$PM_{2.5}$</u>

The new EU Directive makes provision for targets and obligations relating to $PM_{2.5}$. This Directive has not yet been transposed into UK legislation and there are currently no limit values set for $PM_{2.5}$ within the Air Quality Standards Regulations, although the Air Quality Strategy sets out an annual-mean objective of 25 $\mu g.m^{-3}$ to be met by 2020. Consequently, this is a non-statutory obligation.

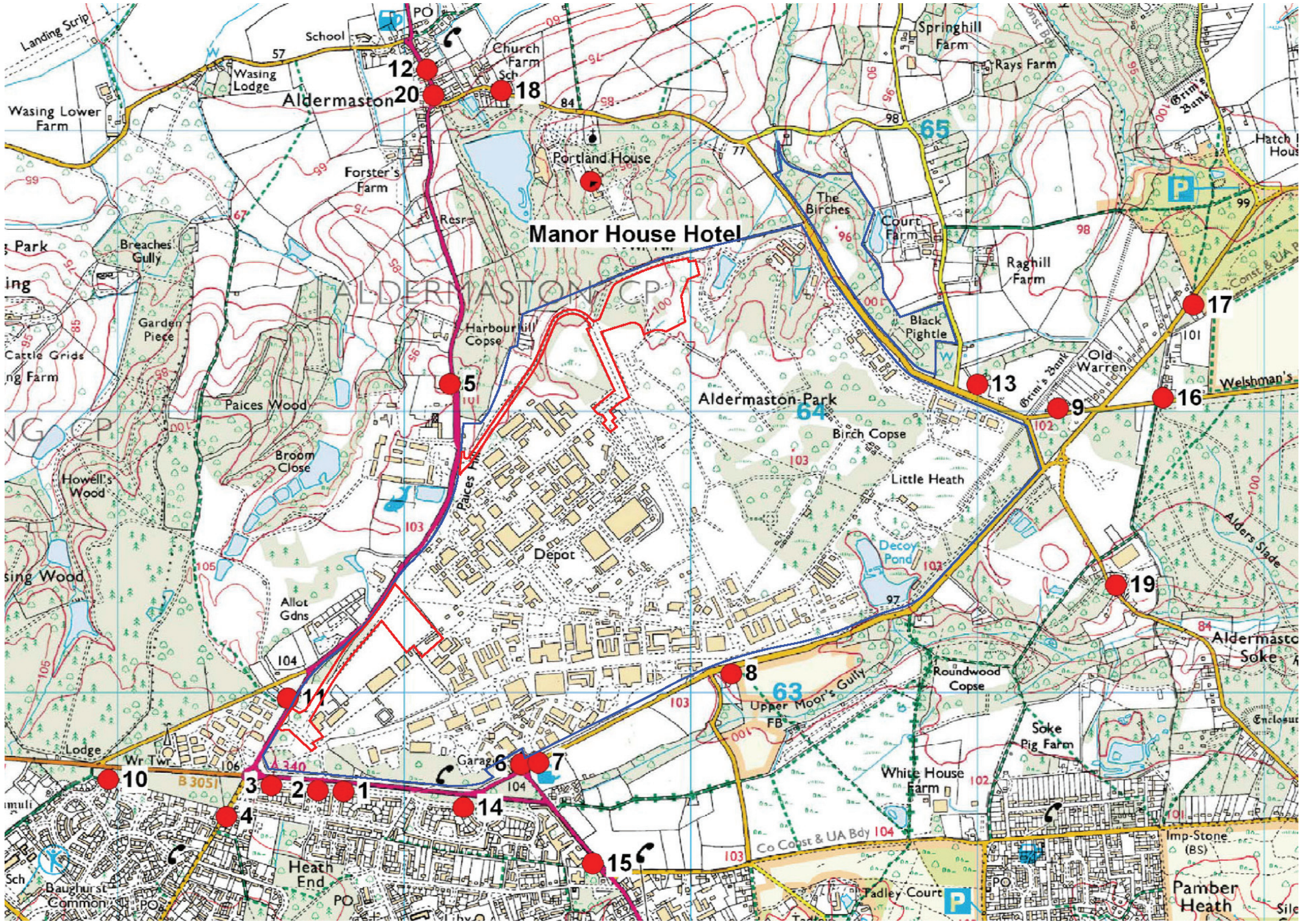
Generally, the smaller a particle is, the longer it can remain suspended in the atmosphere. Fine particles, $PM_{2.5}$, can remain in the atmosphere for weeks and can drift many miles, potentially causing pollution problems in other countries. Particulate matter in the atmosphere is due to a wide range of sources: both primary emissions from natural and anthropogenic sources; and secondary formation of aerosols and mists from reactions in the atmosphere. The significant contribution of this secondary particulate matter makes the control of $PM_{2.5}$ pollution levels very difficult and local improvements will have a limited effect without international action.

Traffic speed related data relating to emissions of $PM_{2.5}$ are not readily available; therefore a semi-quantitative assessment of this pollutant has been carried out rather than dispersion modelling.

<u>Receptors</u>

Figure 10-1 illustrates the location of 20 potentially sensitive receptors in relation to the Proposed Development. These receptor locations and the distances of each from the road centre are detailed in Table 10-5. These receptors have been used to determine the effects of vehicle emissions during the construction phase of the Proposed Development.

Figure 10-1: Receptor Locations for Construction Traffic Emissions



N

0m 2km

Table 10-5: Roads Used to Model Air Quality at Each Receptor

Receptor Number	Receptor	Distance to closest Road(s) (m)	Road Name
1	2 Burnham Rd	36.3	A340 Aldermaston Road
2	1 Heather Drv	40.8	A340 Aldermaston Road
3	10 Plantation Rd	36.7	A340 Aldermaston Road
		89.4	Heath End Road
4	50 Heath End Rd	12.7	Heath End Road
		194.3	A340 Aldermaston Road
5	48 Paices Hill	23.4	A340 Paices Hill
6	Falcon (PH) Reading Rd	13.2	Reading Road
		130.0	A340 Mulfords Hill
7	17 Reading Rd	9.5	Reading Road
		68.0	A340 Mulfords Hill
8	Circus Farm Reading Rd	31.7	Reading Road
9	Old Warren	22.3	Red Lane South of Boiler Gate
		116.6	Reading Road
		106.7	Soke Road
10	105 Long Grove	54.9	B3051
		82.8	Link Road
11	55 Paices Hill	18.8	A340 Paices Hill
		66.8	Link Road
12	The Street, Aldermaston	7.7	Aldermaston Village
		137.2	Red Lane (North of BHG)
13	Red Lane	43.0	Red Lane (North of BHG)
14	28 Almswood Road	49.5	Aldermaston Road
15	2 Police Houses	18.2	A340 (Mulfords Hill)
16	Welshmans Road	14.5	Welshmans Road
		139.0	Reading Road (North of Welshmans Rd)
17	Reading Road	20.0	Reading Road (North of Welshmans Rd)
18	Church Road	11.6	Red Lane (North of BHG)
19	Soke Road	16.7	Soke Road (South of RBT)
20	37 The Street, Aldermaston	10.1	Aldermaston Village
		35.2	Red Lane (North of BHG)

<u>Significance Criteria for Construction Vehicle Effects</u>

A number of approaches can be used to determine whether the potential air quality effects of a development are significant However, there remains no universally recognised definition of what constitutes ‘significance’.

Guidance is available from a range of regulatory authorities and advisory bodies on how best to determine and present the significance of effects within an air quality assessment. It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively.

Presentation of numerical effects allows comparison with relevant UK AQS objectives. Within this assessment, the following information will be presented for each receptor where pollutant concentrations have been determined:

- Absolute pollutant concentrations without the Proposed Development (at existing receptors);
- Absolute pollutant concentrations with the Proposed Development (at existing receptors); and
- Percentage change in concentrations as a result of the Proposed Development (at existing receptors).

Where appropriate, the above information will also be provided in relation to the number of days or hours when concentrations are above or below the relevant AQS objective.

In order to ensure that the descriptions of effects used within this Chapter are clear, consistent and in accordance with recent guidance, definitions have been adopted from the National Society for Clean Air (NSCA) Development Control: Planning for Air Quality document (Ref. 10-21). Table 10-6 provides descriptors used for changes in NO_2 and PM_{10} concentrations as a result of the Proposed Development.

Table 10-6: Magnitude Descriptors for Changes in Pollutant Concentrations as a Percentage of the Relevant AQS Objective/Limit Value

Descriptor	NO_2/PM_{10} Concentrations
Very large	Increase/decrease > 25%
Large	Increase/decrease 15 - 25%
Medium	Increase/decrease 10 - 15%
Small	Increase/decrease 5 – 10%
Very Small	Increase/decrease 1 – 5%
Extremely Small	Increase/decrease < 1%

The magnitude descriptor identified must be considered in the context of existing air quality conditions within the study area in order for the significance of the effect to be determined. The most important aspects to consider are whether existing concentrations are above or below the relevant AQS objective and whether existing receptors are within an Air Quality Management Area (AQMA).

Table 10-7 provides descriptors for the significance of air quality effects based on the magnitude of increase in concentrations as result of the Proposed Development. The NSCA guidance recognises that professional judgement is required in the interpretation of air quality assessment significance.

Table 10-7: Descriptors for Impact Significance for NO_2 and PM_{10} when Concentrations Increase with Proposed Development

Absolute Concentrations in Relation to Standard	Magnitude of Change in Concentrations due to the Proposed Development					
	Extremely Small	Very Small	Small	Medium	Large	Very Large
Above standard without scheme	Slight adverse	Slight adverse	Substantial adverse	Substantial adverse	Very substantial adverse	Very substantial adverse
Below standard without scheme, above with scheme	Slight adverse	Moderate adverse	Substantial adverse	Substantial adverse	Very substantial adverse	Very substantial adverse
Below standard with scheme, but not well below	Negligible	Slight adverse	Slight adverse	Moderate adverse	Moderate adverse	Substantial adverse
Well below standard with scheme	Negligible	Negligible	Slight adverse	Slight adverse	Slight adverse	Moderate adverse

Notes: The NSCA example had been used as a framework for this assessment; however, professional judgment is still required to determine the significance of any change.
‘Well below standard’ =< 75% of the standard level,
‘Standard’ = AQS objective or limit value
Adapted from NSCA guidance

10.3.4 Operational-Phase Assessment Methodology – Non Radiological Emissions

10.3.4.1 Receptors

Two grids of receptors have been included in the dispersion modelling, one a fine resolution grid based with a grid spacing of 36 metres. This grid has been sized based on the Environment Agency’s recommendation that the grid resolution should be equal to 1.5 times the proposed stack height. A second grid of receptors with a resolution of 150 metres has also been included to ensure that any effects further from the site are captured in the dispersion modelling. A receptor representing the Manor House Hotel has also been included in the dispersion model. On-site receptors on the AWE Aldermaston Site have been excluded from the dispersion modelling as the AQS objectives only apply in areas where members of the public may have regular access and as such they do not apply on the AWE Aldermaston Site.

10.3.4.2 Modelled Scenarios

- Open Firing; and
- Contained Firing.

10.3.4.3 Dispersion Model

A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources. The assessment of emissions from the Proposed Development has been undertaken using AERMOD (Ref. 10-22), developed by AERMIC (the American Meteorological Society / Environmental Protection Agency Regulatory Model Improvement Committee). AERMOD is accepted by the Environment Agency (EA) for the modelling of steady state emission sources.

Notable features of AERMOD include its ability to treat the vertical heterogeneous nature of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources, a three-plume model for the convective boundary layer, and limitation of vertical mixing in the stable boundary layer.

AERMOD PRIME integrates the Plume Rise Model Enhancements (PRIME) algorithms into the AERMOD model. The PRIME model was designed to incorporate the two fundamental features associated with building ‘downwash’:

- Enhance plume dispersion coefficients due to the turbulent wake; and
- Reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increase entrainment in the wake.

AERMOD is a modelling system with three separate components and these are as follows:

- AERMOD (AERMOD Dispersion Model);
- AERMAP (AERMOD Terrain Pre-processor); and
- AERMET (AERMOD Meteorological Pre-processor).

AERMET is the meteorological pre-processor for AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters.

AERMAP is a terrain pre-processor designed to simplify and standardise the input of terrain data for AERMOD. Input data include receptor terrain elevation data. For each receptor, the output includes a location and height scale, which is an elevation used for the computation of air-flow around hills.

10.3.4.4 Dispersion Model Set-up

AERMOD requires the user to input a variety of data including meteorological data, emissions data and building parameters. The data included in the dispersion modelling are set out in the following sections.

<u>Building Wake Effects</u>

The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. Where building heights are greater than about 30 - 40% of the stack height, downwash effects can be significant. The dominant structure (i.e. that most likely to promote local turbulence) is the Operations Building. The dimensions of the buildings included within the model are listed in Table 10-8.

Table 10-8: Dimensions of Buildings Included Within the Dispersion Model

Building	National Grid Reference	Height (m)	Length (m)	Width (m)	Angle (°) from North
Operations Building	459814, 164401	21	58.5 (Radius)		Circular
Support Building Tier 1	459911, 164438	6.3	28	44	326
Support Building Tier 2	459934, 164454	9.2	17	44	326
Support Building Tier 3	459948, 164463	14	26	44	326
Substation	459694, 164368	5.6	34	5.2	291

<u>Emissions Data</u>

Emissions from the Proposed Development are associated with emissions of treated air from the work area and chamber. The air will be discharged through a two stage high efficiency particle arrestment (HEPA) filter, with air from open-firing scenarios passed through a wet scrubber upstream from the HEPA filters. The rapid ventilation system allows 15 air changes per hour and will operate for a period of 1 hour following an open firing test.

Air from the contained firings will be passed though inline HEPA filters within the vessel and a dry scrubber system upstream of the two stage HEPA filtration system. Air will be drawn through the ventilation system under a 'normal' flow rate, equating to 5 air changes per hour.

It is anticipated that there will typically be ten firings each year. The emission parameters for both open and contained firings are provided in Table 10-9.

Table 10-9: Modelled Emission Parameters

Parameters	Units	Open Firing	Contained Firing
Stack Height	m	23.5	23.5
Efflux Velocity (min)	$m.s^{-1}$	17	17
Flow Rate – Actual (min)	$m^3.s^{-1}$	5.54	0.0294
Emission Temperature	^oC	32	Ambient
Calculated outlet cone diameter (to achieve 17 $m.s^{-1}$ efflux velocity)	m	0.64	0.05

* The modelling assumes that one of the two flues in the stack will vent the air from the open chamber; the other will be used to vent the air from the contained tests (special and stimulant vessel). To ensure that the special vessel firing has an emission velocity of at least 17 $m.s^{-1}$ then the outlet cone serving the contained firing stack must be 0.05 m in diameter.

The pollutant emission rates have been calculated based on emission data provided by AWE. Emissions have been considered for only those pollutants for which AQS objectives or Environmental Assessment Levels (EALs) exist. The pollutants considered in the assessment and their emission rates are detailed in Table 10-10.

Table 10-10: Mass Emissions ($g.s^{-1}$) of Relevant Pollutants for Each Firing Scenario

Pollutant Considered	Open Firing	Contained Firing
NO_2*	0.158	-
CO	0.268	0.001
HCl	0.014	0.009
HF	-	0.012
HCN	0.005	0.006
N2	5096.28	48.99
$COCl_2$	2.73 x 10-5	-
CH_3OH	2.33 x 10-8	-
F_2	3.72 x 10-11	-
CH_2O	2.59 x 10-11	-

* Emissions have been reported as NO_x as NO_2 in accordance with the data provided by AWE

<u>Maximum Hourly Discharge</u>

The maximum hourly discharge has been modelled for each of the firing scenarios based on the assumption that firing takes place every hour of the year for the five years of meteorological data and the maximum hourly ground level concentration has been reported. This is a very conservative assumption as firings only take place over a one hour period and typically only 10 firings will be undertaken each year, It is therefore highly unlikely that a firing will take place during worst-case meteorological conditions for dispersion. The maximum ground-level concentration for each of the firing options is provided in the results section.

<u>Annual Discharge</u>

Annual ground level concentrations have been predicted by taking the maximum hourly concentration, multiplying it by ten to represent the ten tests that will typically take place each year and dividing it by the number of hours in a year (8760 hours) to predict and annual average concentration for the two firings options. This approach has been taken to allow a comparison of emissions to long-term EAL and annual AQS objectives.

<u>Meteorological Data</u>

The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability as described below:

- Wind direction determines the sector of the compass into which the plume is dispersed;
- Wind speed affects the distance that the plume travels over time and can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise; and
- Atmospheric stability is a measure of the turbulence of the air particularly its vertical motion. It therefore affects the spread of the plume as it travels away from the source. AERMOD uses a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

For meteorological data to be suitable for dispersion modelling purposes, a number of meteorological parameters need to be measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There are only a limited number of sites where the required meteorological measurements are made. The closest meteorological station to the AWE Aldermaston Site for which the Meteorological Office supply data is Heathrow Airport (approximately 47 km east north east of the site).

The year of meteorological data that is used for a modelling assessment can have a significant effect on source contribution concentrations. Dispersion model simulations were performed for emissions from the Hydrus Facility using five years of data from Heathrow Airport between 2003 and 2007.

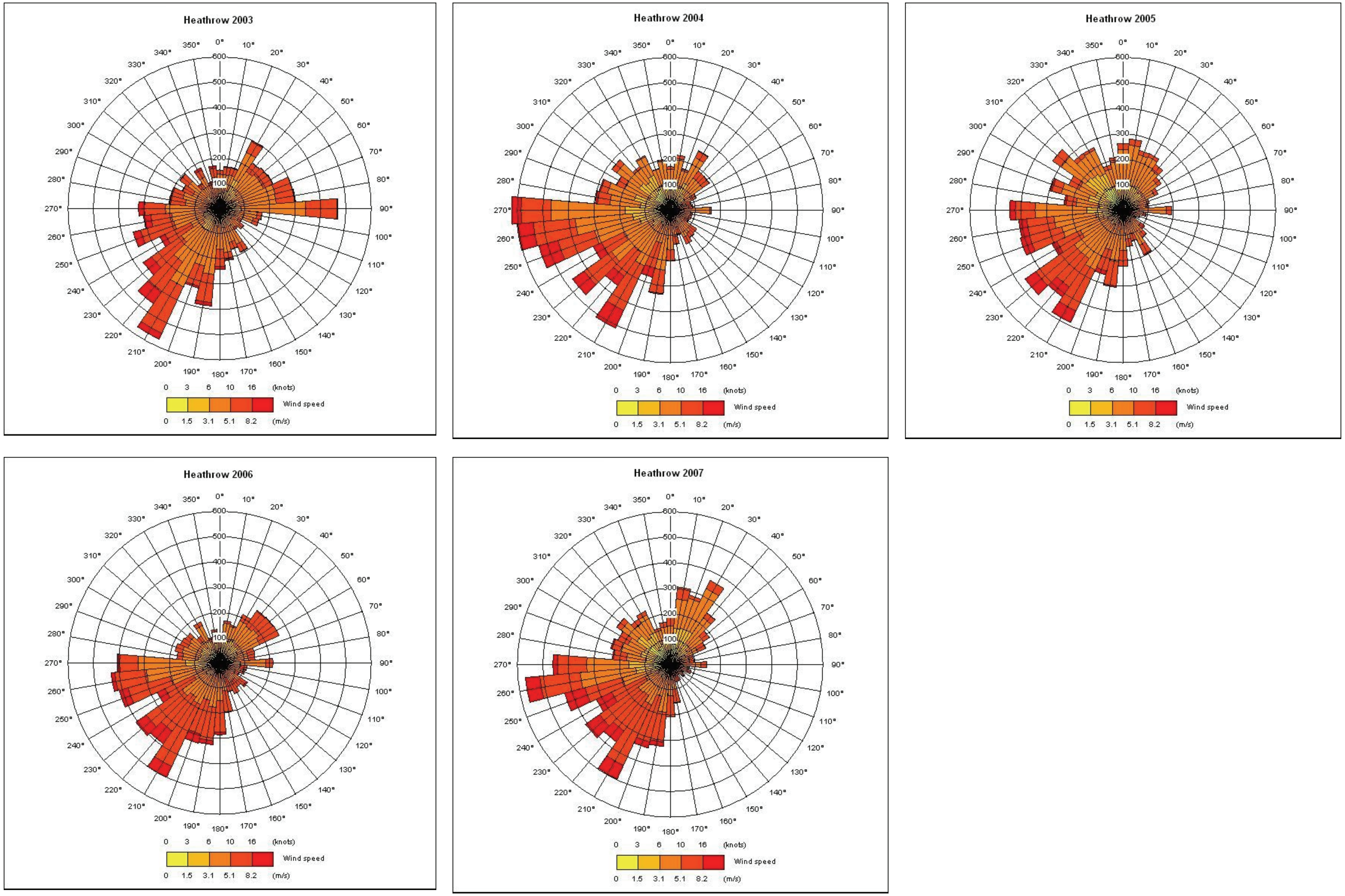
Windroses have been produced for each of the years of meteorological data used in this assessment and are shown in Figure 10-2.

<u>Pre-processing of Meteorological Data</u>

AERMOD requires that meteorological data is processed before it can be used in dispersion modelling. Pre-processing of the meteorological data allows the differences between the site where the data is collected and the modelling domain to be taken into account including:

- Latitude, longitude and time differences;
- Surface roughness length accounts for the effects on wind turbulence as it passes over different surfaces, with large urban areas given a high surface roughness due to the presence of buildings, while water bodies have a low surface roughness. The roughness of the terrain over which a plume passes can have a significant effect on dispersion by altering both the velocity profile with height and the degree of atmospheric turbulence;
- The bowen ratio describes the energy flux from the earths surface to the air, effecting evaporation and air parcel movement; and

Figure 10-2: Windroses for Heathrow Meteorological Data 2003 to 2007



- The albedo rate describes the amount of solar radiation reflected from the earths surface compared to the amount that strikes it (sand and snow have a high reflectivity therefore a high albedo rate, while forests and turned earth have a low reflectivity and low albedo rate) and as such feeds into the calculation of the bowen ratio.

The surface roughness, bowen ratio and albedo rate are determined based on the predominant land use, in each ten degree sector, extending for 3 km from the emission point or site centre. The values used in the pre-processing of the Heathrow meteorological data are reported in Table 10-11.

Table 10-11: Assumed Meteorological Processing Conditions

Sectors (degrees)	Land Type	Albedo Rate	Bowen ratio	Surface Roughness (m)
260-110	Cultivated	0.28	0.75	0.0725
110-230	Urban	0.2075	1.625	1
230-260	Deciduous Trees	0.215	0.875	0.9

10.3.4.5 Significance Criteria for Stack Emission Effects

In order to ensure that the descriptions of effects used within this chapter are clear, consistent and in accordance with recent guidance, definitions have been adopted from the Environment Agency's H1 Guidance (Ref. 10-23). Table 10-12 provides a summary of criteria that should be used to:

- Screen out insignificant emissions;
- Identify when detailed dispersion modelling is required; and
- Assess the significance of effects against air quality criteria.

Table 10-12: Summary for the Assessment of Stack Emissions to Air – H1 Methodology

Parameter	Long-term	Short-term
Criteria for screening out Insignificant Emissions	Emissions can be seen as insignificant where: $PC_{long\text{-}term} \leq 1\%$ of long-term EAL / EQS	Emissions can be seen as insignificant where: $PC_{short\text{-}term} \leq 10\%$ of long-term EAL / EQS
Criteria for detailed air modelling	Detailed air modelling is required if: $PC_{Long\text{-}term}$ >70% of long-term EAL / EQS or where there is an AQMA / AQAP for a substance	Detailed air modelling is required if: $PC_{short\text{-}term}$ >20% of (short-term EAL / EQS minus the long-term background concentration) or where there is: local human population
Acceptability against local Environmental Quality Requirements	If Long-term background > EU EQS or $PEC_{long\text{-}term}$ > long-term EU EQS then consideration of further control measures is required. If long-term background > long-term National EQS or $PEC_{long\text{-}term}$ > long-term National EQS then the operator needs to justify that further control measures are not required. Comparison with EALs can be treated as for National EQS	If $PEC_{short\text{-}term}$ (PC short-term plus twice the long-term background) > short-term National EQS then the operator needs to justify that further control measures are not required

Notes PC = process contribution
PEC = predicted environmental concentration (PC plus background concentration)
EAL = Environmental Assessment Level
EQS = Environmental Quality Standard
AQMA = Air Quality Management Area
AQAP = Air Quality Action Plan

The criteria summarised in Table 10-12 have been used in developing the magnitude descriptors that have been applied to the results of this assessment presented in Table 10-13. The significance descriptors listed in Table 10-14 have been adapted from the NSCA (and provide the significance of air quality impacts based on the magnitude of change in the context of existing baseline conditions, as set out in Section 10.4).

Table 10-13: Magnitude Descriptors for Process Contributions as a Percentage of EAL / EQS for the Assessment of Emissions to Air

Magnitude Descriptor	Averaging Period and Process Contribution as % of EAL / EQS	
	Long-term	Short-term
Extremely Small	< 1%	< 10%
Very Small	1 – 5%	10 – 15%
Small	5 – 10%	15 – 20%
Medium	10-15%	20 – 25%
Large	15 – 25%	25 – 50%
Very Large	> 25%	> 50%

Table 10-14: Descriptors for Impact Significance for Process Contributions

Absolute Concentrations in Relation to Standard	Magnitude Descriptor					
	Extremely Small	Very Small	Small	Medium	Large	Very Large
Above standard	Slight adverse	Slight adverse	Moderate adverse	Substantial adverse	Very substantial adverse	Very substantial adverse
Below standard	Negligible	Slight adverse	Slight adverse	Moderate adverse	Moderate adverse	Substantial adverse
Well below standard	Negligible	Negligible	Slight adverse	Slight adverse	Slight adverse	Moderate adverse

Notes: The NSCA example had been used as a framework for this assessment; however, professional judgment is still required to determine the significance of any change.
'Well below standard' = < 75% of the standard level
'Standard' = AQS objective or limit value
Adapted from NSCA guidance

10.3.5 Operational-Phase Assessment Methodology – Radiological Emissions

10.3.5.1 Receptors

The radiological effects of emissions from the Proposed Development have been assessed at the Manor House Hotel which has been identified as the closest sensitive receptor.

10.3.5.2 Radiological Emission Modelling

The radiological effects of emissions from the Proposed Development have been assessed using the Individual Doses for AWE Sites (INDAS) model. INDAS is a mathematical model applied to atmospheric and liquid discharges of radionuclide's which was adapted from the European Commission (EC) Consequences of Releases to the Environment Assessment Methodology (CREAM) specifically for the AWE sites by the National Radiological Protection Board (NRPB) – currently the Radiation Protection Division of the Health Protection Agency.

CREAM has been developed to assess the dispersion and possible accumulation of radionuclides in the environment based on exposure pathways and is used to estimate the annual dose. The factors considered by CREAM include:

- Dispersion in the atmosphere;
- Deposition from the atmosphere;
- Re-suspension of deposited radionuclides;
- Inhalation;
- External irradiation by material (atmospheric and deposited); and
- Trophic transfer and bioaccumulation.

The Critical Group Dose has been calculated from the INDAS model results using the International Commission on Radiological Protection (ICRP) 60 dosimetry. The Critical Group Dose at the Manor House Hotel has been calculated for the 50th year of discharges, allowing for accumulation in the environment, in accordance with standard practice.

The INDAS modelling for the Proposed Development has been undertaken by AWE and the results are reported in Section 10.5.1.2.

10.3.5.3 Model Setup

Emissions Data

Radiological and toxicological discharges are controlled by regulations through the Environment Agency and have been supported and underpinned by BPM, ALARP and BAT assessments to mitigate discharges and impacts on the environment and humans. Assessments have been undertaken inline with current and pending legislation. AWE has undertaken a dose assessment which supports the design of the abatement system

Radiological emissions are higher during open firing events as the contained firing vessel has inline HEPA filters to minimise release from the vessel. As such, the radiological assessment has been undertaken using emission parameters for open firing events as detailed in Table 10-15.

Table 10-15: Modelled Radiological Emission Parameters

Parameters	Units	Open Firing
Stack Height	m	24
Discharge rate – U-234	$Bq.y^{-1}$	0.83
Discharge rate – U-238	$Bq.y^{-1}$	4.2
Discharge rate – Cs-137	$Bq.y^{-1}$	6.6

These calculations take into account current research facility which will be replaced by the Proposed Development. As such the assessment of radiological emissions is conservative. Note – Cs-137 is provided as a substitute for daughter isotopes of Uranium.

10.4 Baseline Air Quality Conditions

10.4.1.1 Sources of Information on Background Levels

Information on background air quality in the UK is usually available from two public sources:

- Each local authority has published the results of its Review and Assessment (R&A) of air quality, with reference to local monitoring and modelling studies, providing a description of air quality at both kerbside and non-kerbside locations; and
- The National Air Quality Information Archive (NAQIA) includes projections of background (non-kerbside) concentration for years up to 2010 for each 1 km grid square in the UK.

This information can be supplemented by site-specific or other local monitoring campaigns. However, for this assessment, there is sufficient information available from the NAQIA and the results of R&A's undertaken by Basingstoke and Deane Borough Council (BDBC) and West Berkshire Council (WBC).

10.4.2 Local Authority Review and Assessment Work

10.4.2.1 Basingstoke and Deane Borough Council (BDBC)

In 2003 BDBC completed an Updating and Screening Assessment (USA) (Ref. 10-24) in order to identify significant changes in air quality issues since the first R&A exercise. The report concluded that all AQS objectives were likely to be met in the Borough and therefore there was no requirement to proceed with further assessment.

BDBC produced a Progress Report produced in 2004 (Ref. 10-25) which reviewed new monitoring data collected during 2003. The report concluded that a Detailed Assessment was required for NO_2 at a road junction at Winchester Street and Winton Square, Basingstoke, approximately 11.5 km to the south, south east.

The Detailed Assessment was published in 2005 (Ref. 10-26) and concluded that despite an exceedence of the AQS objectives at one residential property, the property was only used as a break area serving a restaurant. Therefore there was not any relevant exposure and an Air Quality Management Area (AQMA) should not be declared, though further monitoring was recommended.

BDBC completed its next USA in 2006 (Ref. 10-27) and published further Progress Reports for both 2007 (Ref. 10-28) and 2008 (Ref. 10-29). No exceedences of AQS objectives were identified in the council area with the exception of Winchester Street/ Winton Square Junction. However, it was determined that there was no relevant exposure and an AQMA was not required.

10.4.2.2 West Berkshire Council (WBC)

The West Berkshire USA carried out in 2003 (Ref. 10-30) confirmed the findings of the previous reports and concluded that no further Detailed Assessments were required for any AQS pollutants as no exceedences of the objectives were anticipated.

WBC's Progress Report in 2004 noted that concentrations of NO_2 in the District had increased since the USA (Ref. 10-31). However, no predicted exceedences of any AQS objectives were identified.

The Progress Report in 2005 identified possible exceedences of the AQS objective for NO_2 in close proximity to busy roads in Newbury (Ref. 10-32), although the report did not recommend progression to a Detailed Assessment.

A further USA was completed in January 2007 (Ref. 10-33). This concluded that overall there had been a downward trend in NO_2 since 2003 despite the findings of the 2005 Progress Report. The assessment concluded that the AQS objectives would be met at all locations with the exception of the Newbury roundabout where the A343, A339 and Greenham Road intersect, which required additional consideration as part of a Detailed Assessment.

The 2008 Detailed Assessment (Ref. 10-34) reported the findings of a monitoring program commenced at the roundabout. The Detailed Assessment identified that the annual NO_2 objective would be exceeded at the facades of residential properties while the 1-hour objective was exceeded at the continuous monitor. The assessment recommended the declaration of an AQMA in relation to annual mean and 1-hour mean NO_2 concentrations at the Newbury roundabout and the preparation of an Air Quality Action Plan (AQAP).

In 2009 WBC declared an AQMA incorporating parts of the A339 at the junction of the A343 and Greenham Road in Newbury (Ref. 10-35), approximately 12 km to the west north west, due to likely exceedences of the annual and hourly AQS objectives for NO_2. The 2009 USA identified several areas close to busy or narrow congested streets which would need further consideration as part of a Detailed Assessment. No other sources were found to need further assessment. This AQMA is over 10 km from the AWE Aldermaston Site and as such it is unlikely that construction traffic associated with the construction phase of the Proposed Development or stack emissions will have any significant impact upon it.

10.4.3 Background Data from Monitoring

Air quality monitoring locations are classified according to their proximity to local emission sources. Roadside diffusion tube sites are typically within 1 to 5 metres of the kerbside but may extend up to 15 metres from the kerb depending upon the road configuration and traffic flow. Pollutant concentrations measured at sites classified as urban background are away from the influence of local emission sources and are therefore broadly representative of the underlying background pollution levels in residential areas within large conurbations. For the purposes of deriving an air quality baseline for impact assessments, only non-roadside monitoring sites are considered representative and included in this assessment.

10.4.3.1 Monitoring by Basingstoke and Deane Borough Council (BDBC)

Table 10-16 sets out the bias-corrected urban background diffusion tube monitoring results, collected by BDBC for the years 2005 to 2008. Bias adjusted data is not yet available for 2009.

Table 10-16: BDBC Urban Background Diffusion Tube Data

Site Name	Dist to site (km)	Annual mean NO_2 Concentrations ($\mu g.m^{-3}$)			
		2005	2006*	2007*	2008*
Lambs Row Lychpit	11.3	24.45	19.9	22	20
Stocker Close, Basingstoke	12.7	23.37	19.2	20	21
Four Lane School, Hanmore Road	9.7	19.07	16..9	18	16
North Foreland Lodge, Sherfield On Loddon	10.2	18.60	15.3	17	**
Sewage Treatment Works, Chineham	11	14.61	12.7	14	**
Wildwood Cottage, Newnham Lane	12.2	17.53	14.8	14	**
Eastrop allotments (triplicate tubes)	11.5	23.88	22.2	**	**

*Note: * bias adjusted using combined factor*
*** discontinued*

The BDBC diffusion tube data do not show any trend in NO_2 concentration, which has remained relatively constant over the three years.

BDBC also operated an urban background automatic monitor located at Eastrop Way, Basingstoke (approximately 11.5 km from the Application Site) until June 2006 which measured concentrations of PM_{10}, and NO_2. The Eastrop Way site was decommissioned in June 2006. In 2005, monitoring at Eastrop Way did not record any exceedences of the annual or hourly-mean AQS objectives for NO_2.

Table 10-17 presents annual mean concentrations from the continuous monitor for 2005. Data for PM_{10} concentrations at this monitoring station in 2005 are only available for January to April. Calculation of an annual mean is not appropriate as the data capture rate is below the recommended rate of 90%. A period mean has therefore been calculated.

Table 10-17: BDBC Continuous Automatic Monitoring Results (μg.m-³)

Year	NO_2	PM_{10}
2005	26	15.8 [(a)]
2006	28 [(b)]	-

Notes: [(a)] Period average calculated from data available for January to April. The site ceased collecting PM_{10} data after April 2005.
[(b)] Period average calculated from data available for January to June. The site ceased operating in June 2006.

10.4.3.2 Monitoring by West Berkshire Council (WBC)

Table 10-18 sets out the bias-corrected urban background diffusion tube monitoring results, collected by WBC for the years 2005 to 2008.

Table 10-18: WBC Operated Background Diffusion Tubes

Site Name	Distance to Site (km)	Direction to Site	Annual mean NO_2 Concentrations ($\mu g.m^{-3}$)			
			2005	2006	2007	2008
Hungerford Primary School	25.5	WNW	13.8	-	-	-
Chaddleworth Primary School	22	NW	10.5	12	10	12
Springfield Primary School, Tilehurst	10.5	NE	16.4	-	-	-
Upper Basildon Primary School	12	N	12.9	-	-	-

Note: Bias adjusted data is not yet available for 2009.

WBC also has a series of roadside diffusion tubes, including one on The Street in Aldermaston village (Table 10-19) Whist it is not appropriate to use this to establish background concentrations of NO_2, the results are nevertheless useful as they can be compared to the roadside concentrations predicted by DMRB in order to help verify the predicted concentrations.

Table 10-19: WBC Operated Roadside Diffusion Tubes in the Vicinity of AWE Aldermaston

Site Name	Annual mean NO_2 Concentrations ($\mu g.m^{-3}$)		
	2006	2007	2008
37 The Street, Aldermaston	25	26	32

Note: Bias adjusted data is not yet available for 2009.

10.4.3.3 Monitoring by Atkins Nuclear

In 2005, Atkins Nuclear carried out an Environmental Site Setting Exercise in order to describe the environmental setting of the AWE Aldermaston Site. The report was intended to develop baseline conditions for future environmental assessments and included a consideration of air quality (Ref. 10-36).

Atkins reviewed all measured concentrations of pollutants from their monitoring stations and concluded that they were below the AQS objectives with the exception of NO_2 and PM_{10}. Exceedences of the hourly and annual mean NO_2 objective, and 24-hour PM_{10} objective, were reported at the Theale continuous automatic monitoring station in 2003. This station is located adjacent to the M4, approximately 10 km from the AWE Aldermaston Site.

Atkins also carried out a diffusion tube monitoring survey for NO_2 at twenty six locations in and around the AWE Aldermaston and AWE Burghfield sites between 26th March 2003 and 30th April 2004. Table 10-20 presents the mean NO_2 concentration for each site over the monitoring period.

Table 10-20: Diffusion Tube Data (Atkins Nuclear)

Site Number	Site Location	Mean NO_2 ($\mu g.m^{-3}$)
A1	Aldermaston - Centre of site	16.4
A2	Aldermaston - South of site	17.6
A3	Aldermaston - East of site near boiler house	15.5
A4	Aldermaston - South west of site	17.5
B1	Burghfield - North of site	18.8
B2	Burghfield - North east of site	18.9
B3	Burghfield - East of site	17.9
B4	Burghfield - North west of site	17.6
C	A4 - Near Radio 210, Calcot	33.5
D	Burghfield Road - At junction of Dwyer Road, Reading	30.7
E	Burghfield Road - at entrance of Theale landfill, north of Burghfield	27.4
F	Reading Road - Near Hatch Gate Inn, Burghfield	20.6
G	Pingewood Road - Near Moores Farm, north-east of Burghfield	21
H	Great Lea Common	23.1
I	Burghfield Common	22.8
J	Goring Lane - East of Burghfield Common	17.7
K	Mereoak Lane - Near Grazeley Primary School	21.7
L	A340 - At junction with Church Road, Aldermaston	22.1
M	Padworth Road - Near Manor House, west of Mortimer	20.2
N	Victoria Road - Mortimer	16.6
O	The Street - Near St Mary's Primary School, Stratfield Mortimer	18.5

Notes: All data-bias corrected by Atkins Nuclear using diffusion tubes co-located with a continuous monitor

The diffusion tube results indicate that air quality in the immediate vicinity of the site is good. Concentrations monitored at all sites comply with the NO_2 annual mean AQS objective of 40 $\mu g.m^{-3}$.

10.4.3.4 UK Nitric Acid Monitoring Network – Hydrogen Chloride Monitoring

Hydrogen chloride (HCl) is monitored as part of the Nitric Acid Monitoring Network, which forms part of the Acid Deposition Monitoring Network (Ref. 10-37). The nitric acid network was established in 1999 and covers 12 rural sites across the UK. The closest monitoring site to AWE Aldermaston is at Harwell. The annual average HCl concentration recorded in 2008 at Harwell was 0.32 $\mu g.m^{-3}$, well below the long-term EAL of 20 $\mu g.m^{-3}$.

10.4.3.5 Expert Panel on Air Quality Standards – Hydrogen Fluoride Monitoring

The Expert Panel on Air Quality Standards (EPAQS) was set up in 1991 to provide independent advice on air quality issues. In 2005 it published a draft report entitled 'Guidelines for halogen and hydrogen halides in ambient air for protecting human health against acute irritancy effects' (Ref. 10-38). The report noted that only a small number of measurements of ambient concentrations of hydrogen fluoride have been made in the UK. All of these have been made in the vicinity of three industrial plants. Many samples were below the limit of detection. However, measurable values were in the range 5 x 10^{-5} $mg.m^{-3}$ to 3.5 x 10^{-3} $mg.m^{-3}$ as approximate monthly averages.

The report concluded that it would be reasonable to expect maximum 1-hour mean hydrogen fluoride concentration to reach about 2.46 x 10^{-3} $mg.m^{-3}$ at rural sites exposed to power station plumes which is low when compared with its suggested appropriate short-term guideline of 160 $\mu g.m^{-3}$.

10.4.4 NAQIA Estimates

Background air quality projections specific to the Hydrus Development Site were collected from the National Air Quality Information Archive (NAQIA) (Ref. 10-39). The archive provides projections of pollution concentrations across the UK at a resolution of 1 km^2 for the objective year of the specified pollutant. Data from this source were collected for four of these 1 km^2 grid squares which cover the Hydrus Development Site. Background pollutant levels for the base year (2008) peak construction year (2014) and opening year (2016), as provided by the NAQIA, are presented in Table 10-21

Table 10-21: NAQIA Estimates ($\mu g.m^{-3}$) for the Development Site

Year	Pollutants	OS Grid Square				Average
		458500, 162500	459500, 162500	458500, 163500	459500, 163500	
2001	**CO**	274	277	274	277	276
2008	**NO_x**	19.9	20.0	19.4	25.7	21.3
	NO_2	15.8	15.9	15.4	19.5	16.6
	PM_{10}	17.4	17.6	17.4	20.7	18.3
	$PM_{2.5}$	11.4	11.5	11.5	13.6	12.0
	CO	149.1	150.7	149.1	150.7	149.9
2014	**NO_x**	16.8	16.8	16.2	22.4	18.1
	NO_2	13.6	13.6	13.2	17.4	14.5
	PM_{10}	16.8	17.0	16.8	20.0	17.7
	$PM_{2.5}$	10.9	11.0	10.9	13.0	11.5
	CO	118.4	119.7	118.4	119.7	119.0
2016	**NO_x**	16.1	16.1	15.5	21.6	17.3
	NO_2	13.1	13.1	12.7	16.9	14.0
	PM_{10}	16.7	16.9	16.7	19.9	17.6
	$PM_{2.5}$	10.8	11.0	10.9	12.9	11.4
	CO	118.1	119.4	118.1	119.4	118.7

Note: Adjusted to remove road contributions.

10.4.5 Summary of Baseline Air Quality

Relevant monitoring data obtained from BDBC and WBC show that concentrations of NO_2 are well below AQS annual mean objectives at all urban background monitoring sites. Annual mean NO_2 concentrations projected by the NAQIA are lower than the Local Authority monitored data and as such will not be used to establish background NO_2 concentrations. However, due to the limited amount of background monitoring undertaken for PM_{10}, estimated NAQIA values for PM_{10} and $PM_{2.5}$ will be used in this assessment.

NO_2 and NO_x concentrations used in the modelling were calculated from the 2005 BDBC continuous monitoring data. The NAQIA NO_2 to NO_x converter was used to calculate background NO_x values from the NO_2 concentration measured by the BDBC. Following a review of the local diffusion tube data no trend in the NO_2 concentrations has been found with values remaining relatively constant between the years. On this basis it has been assumed that the background concentrations of NO_2 and NO_x will remain constant and as such the 2005 continuous monitor if data will be used unadjusted in the assessment. This approach is conservative as Defra predicts that background concentration will reduce over time. Table 10-22 summarises background pollutant concentrations used in the DMRB assessment.

Table 10-22: Summary of Background Concentrations used in the Assessment (μg.m^{-3})

Pollutant	Year			Data Source
	2008	2014	2016	
NO_2	26	26	-	BDBC continuous monitoring data (2005)
NO_x	44.6	44.6	-	BDBC continuous monitoring data [(a)]
PM_{10}	18.3	17.7	-	NAQIA
$PM_{2.5}$	12.0	11.5	-	NAQIA
CO	149.9	119.0	118.7	NAQIA
HCl	0.32	-	-	Harwell AURN Site 2008
HF	2.46	-	-	EPAQS 2005 Report

Notes: [(a)] NO_x calculated using NAQIA NO_2 to NO_x converter

10.5 Potential Impacts and Mitigation Measures

10.5.1 Potential Impacts

10.5.1.1 Construction Phase

Construction Dust Impacts

The level and distribution of construction dust emissions will vary according to factors such as the type of dust, duration and location of dust-generating activity, weather conditions and the effectiveness of suppression measures.

The main effect of any dust emissions, if not mitigated, would be nuisance at nearby sensitive receptors due to soiling of surfaces, particularly windows, cars and laundry.

For the assessment of the construction phase of the Proposed Development, an Air Quality Risk Assessment (AQRA) has been carried out in accordance with the London Best Practice Guidance (LBPG). Construction activities have been assessed against the overarching criteria in Table 10-3.

On the basis of the significance criteria in Table 10-3 the Proposed Development would potentially be at 'High Risk' of causing air quality effects during the construction phase if mitigation measures are not applied. This is due to the redevelopment covering approximately 63,350 square metres of land. However, it is unlikely that dust emissions will have a significant nuisance effect as there are no sensitive receptors within 100 m of the site boundary with the closest receptor to the site being the Manor House Hotel, which is approximately 300 metres to the north north-west.

Nevertheless, mitigation measures that are consistent with the 'High Risk' category are listed in the following mitigation section of this assessment. By incorporating these mitigation measures into the scheme, the likely effects will be reduced to a low level of risk.

Construction Vehicle Emissions Impacts

The Design Manual for Roads and Bridges (DMRB) model has been used to estimate future traffic-related pollutant concentrations from the local road network in the peak construction year (2014). The assessment utilises the DMRB version 1.03c (July 2007) which calculates pollutant concentrations based on empirical relationships between traffic density, speed and distance of sensitive locations from road networks.

Annual-mean NO_2 and PM_{10} concentrations have been predicted at the proposed sensitive receptors using the DMRB model. Annual-mean NO_2 concentrations have been derived from the modelled annual-mean NO_x concentration using the LAQM.TG(09) calculator (Ref.10-5). The assessment of $PM_{2.5}$ has been considered semi-quantitatively because the DMRB model does not predict concentrations of $PM_{2.5}$ as traffic/speed related data for emissions of this pollutant are not readily available.

Nitrogen Dioxide Impacts

Annual-mean NO_2 concentrations predicted by the DMRB modelling at the selected sensitive receptors are presented in Table 10-23.

Table 10-23: Predicted Annual-Mean NO_2 Concentrations (μg.m^{-3})

Receptor	2008 Base	2014 Base	2014 With	Change (% of AQS)	Magnitude of Change	Significance Descriptor
1	28.9	28.3	28.3	<0.1	Extremely Small	Negligible
2	28.7	28.1	28.1	<0.1	Extremely Small	Negligible
3	29.2	28.5	28.5	<0.1	Extremely Small	Negligible
4	27.9	27.6	27.6	<0.1	Extremely Small	Negligible
5	29.0	28.4	28.5	0.1	Extremely Small	Negligible
6	28.6	28.3	28.3	<0.1	Extremely Small	Negligible
7	29.9	29.3	29.3	<0.1	Extremely Small	Negligible
8	27.4	27.3	27.3	<0.1	Extremely Small	Negligible
9	26.9	26.9	26.9	<0.1	Extremely Small	Negligible
10	27.3	27.1	27.1	<0.1	Extremely Small	Negligible
11	29.2	28.5	28.5	<0.1	Extremely Small	Negligible
12	31.4	30.5	30.7	0.2	Extremely Small	Negligible
13	26.3	26.3	26.3	<0.1	Extremely Small	Negligible
14	28.2	27.7	27.7	<0.1	Extremely Small	Negligible
15	30.7	29.7	29.7	<0.1	Extremely Small	Negligible
16	26.8	26.7	26.7	<0.1	Extremely Small	Negligible
17	28.3	28.0	28.0	<0.1	Extremely Small	Negligible
18	26.6	26.7	26.7	<0.1	Extremely Small	Negligible
19	26.8	26.8	26.8	<0.1	Extremely Small	Negligible
20	31.4	30.6	30.8	0.2	Extremely Small	Negligible
Min	26.3	26.3	26.3	<0.1	-	-
Max	31.4	30.58	30.77	0.20	-	-

Notes: Results calculated to one decimal place.
Base – Baseline traffic without the proposed construction traffic
With – Baseline traffic with the peak predicted construction traffic included.

In 2008 annual-mean NO_2 concentrations are predicted to range between 26.3 and 31.4 μg.m^{-3} at existing receptors. The annual-mean NO_2 concentration predicted at Receptor 20, is comparable to the NO_2 concentration measured in the field by diffusion tube '37 The Street, Aldermaston' present in Table 10-19. This provides additional confirmation that the background concentrations used in the assessment are appropriate and outputs verified.

In 2014, without the construction traffic, annual-mean NO_2 concentrations are predicted to range between 26.3 and 30.6 μg.m^{-3} at existing receptors. The highest annual-mean NO_2 concentration without the construction traffic is also predicted at Receptor 20.

Note that Receptor 20 is located with '37 The Street, Aldermaston', while Receptor 12 is located at 'The Street, Aldermaston'

With the peak number of construction vehicles, predicted annual-mean NO_2 concentrations range between 26.3 and 30.8 μg.m^{-3}. The highest annual-mean NO_2 concentration with the construction traffic is predicted at Receptor 20. Comparing the with-development and without-development scenarios, the magnitude of the changes is below 1% of the AQS objective, with the greatest increase at Receptor 12 'The Street, Aldermaston'. Using the magnitude criteria set out in Table 10-6, the magnitude of change can be described as "extremely small". When this is considered with the absolute concentrations relative to the AQS objective the significance is deemed 'negligible'.

All annual-mean NO_2 concentrations are predicted to be below 60 μg.m^{-3}. As such the hourly-mean AQS objective of no more than 18 exceedences of 200 μg.m^{-3} per year is likely to be met. The hourly-mean NO_2 objective has, therefore, not been considered further.

Particulate Matter (PM_{10}) Impacts

Predicted annual-mean PM_{10} concentrations are presented in Table 10-24.

Table 10-24: Predicted Annual-Mean PM_{10} Concentrations (μg.m^{-3})

Receptor	2008	2014 WO	2014 W	Change (% of AQS)	Magnitude of Change	Significance Descriptor
1	19.1	18.2	18.2	<0.1	Extremely Small	Negligible
2	18.9	18.1	18.1	<0.1	Extremely Small	Negligible
3	19.1	18.3	18.3	<0.1	Extremely Small	Negligible
4	18.8	18.1	18.1	<0.1	Extremely Small	Negligible
5	18.9	18.1	18.1	<0.1	Extremely Small	Negligible
6	18.9	18.2	18.2	<0.1	Extremely Small	Negligible
7	19.3	18.5	18.5	<0.1	Extremely Small	Negligible
8	18.6	17.9	17.9	<0.1	Extremely Small	Negligible
9	18.5	17.9	17.9	<0.1	Extremely Small	Negligible
10	18.6	17.9	17.9	<0.1	Extremely Small	Negligible
11	18.9	18.2	18.2	<0.1	Extremely Small	Negligible
12	19.7	18.7	18.7	<0.1	Extremely Small	Negligible
13	18.3	17.7	17.7	<0.1	Extremely Small	Negligible
14	18.8	18.0	18.0	<0.1	Extremely Small	Negligible
15	19.6	18.6	18.6	<0.1	Extremely Small	Negligible
16	18.5	17.8	17.8	<0.1	Extremely Small	Negligible
17	18.8	18.2	18.2	<0.1	Extremely Small	Negligible
18	18.4	17.8	17.8	<0.1	Extremely Small	Negligible
19	18.5	17.9	17.9	<0.1	Extremely Small	Negligible
20	19.6	18.7	18.7	<0.1	Extremely Small	Negligible
Min	18.3	17.7	17.7	<0.1	-	-
Max	19.6	18.7	18.7	<0.1	-	-

Notes: Results calculated to one decimal place.
Base – Baseline traffic without the proposed construction traffic
With – Baseline traffic with the peak predicted construction traffic included.

In 2014, without the construction traffic annual-mean PM_{10} concentrations are predicted to range between 17.72 and 18.71 μg.m^{-3}. The highest annual-mean PM_{10} concentration without the construction traffic is predicted at Receptor 20, 'The Street, Aldermaston'.

With the peak number of construction vehicles, annual-mean PM_{10} concentrations range between 17.72 and 18.73 μg.m^{-3}. The highest annual-mean PM_{10} concentration with the construction traffic is predicted at Receptor 20, '37 The Street, Aldermaston'. Comparing the with-development and without-development scenarios, the magnitude of the changes is below 1% of the AQS objective, with the greatest increase at Receptor 12 'The Street, Aldermaston'. Using the magnitude criteria set out in, the magnitude of change can be described as "extremely small". When this is considered with the absolute concentrations relative to the AQS objective the significance is deemed 'negligible'.

All annual-mean PM_{10} concentrations are predicted to be below 31.8 $\mu g.m^{-3}$. This suggests that the daily-mean AQS objective is expected to be met and is not considered further within this assessment.

Fine Particulate Matter ($PM_{2.5}$) Impacts

NAQIA mapped data include estimates of $PM_{2.5}$ concentrations across the UK at a resolution of 1 km^2 for each year. Background concentrations assumed for the assessment have been obtained from the NAQIA and are presented in Table 10-21. In 2014, the annual-mean $PM_{2.5}$ concentration provided for the Application Site by the NAQIA is 11.5 $\mu g.m^{-3}$.

$PM_{2.5}$ (particles with a diameter up to 2.5 µm) is a subset of PM_{10} (particles with a diameter up to 10 µm) concentrations. If the predicted PM_{10} concentration was made up entirely of particles up to 2.5 µm diameter (i.e. $PM_{2.5}$), then the maximum concentration of $PM_{2.5}$ at any receptor would be 15.58 $\mu g.m^{-3}$, well below the 25 $\mu g.m^{-3}$ objective for $PM_{2.5}$.

10.5.1.2 Operational Phase

Traffic Emissions Impacts

The Proposed Development will not result in an increase of road traffic flows on the local network. Therefore, there will be no air quality impacts once the construction phase of the development is completed, as such, this aspect has not been considered further.

Stack Emissions Impacts

Maximum ground level process contributions (PC) and predicted environmental concentrations (PEC) for each of the two firing scenarios are presented in Table 10-25 to Table 10-28. Values have been predicted using five years of Heathrow Airport meteorological data and the maximum concentration reported in each case.

Table 10-25: Open Firing Process Contributions (PC) to Ground Level Concentrations

Pollutant	Averaging Period	AQS/EAL ($\mu g.m^{-3}$)	PC ($\mu g.m^{-3}$)	PC as a % of the AQS/EAL	Magnitude
NO_2	1 Hour 99.79th percentile	200	23.95	11.98	Very Small
	Annual	40	0.03	0.07	Extremely Small
CO	1 Hour Max	10,000	50.9	0.51	Extremely Small
	Annual	350	0.06	0.02	Extremely Small
HCl	1 Hour Max	750	3.80	0.51	Extremely Small
	Annual	20	0.00	0.02	Extremely Small
HCN	1 Hour Max	220	1.36	0.62	Extremely Small
$COCl_2$	1 Hour Max	25	7.4×10^{-4}	3.0×10^{-3}	Extremely Small
	Annual	0.8	8.5×10^{-7}	1.1×10^{-4}	Extremely Small
CH_3OH	1 Hour Max	33300	6.3×10^{-6}	1.9×10^{-8}	Extremely Small
	Annual	2660	7.2×10^{-9}	2.7×10^{-10}	Extremely Small
F_2	1 Hour Max	2.8	1.0×10^{-8}	3.6×10^{-7}	Extremely Small
	Annual	1	1.2×10^{-11}	1.2×10^{-9}	Extremely Small
CH_2O	1 Hour Max	100	7.0×10^{-9}	7.0×10^{-9}	Extremely Small
	Annual	5	8.0×10^{-12}	1.6×10^{-10}	Extremely Small

Table 10-26: Open Firing Predicted Environmental Concentration (PEC)

Pollutant	Averaging Period	AQS/EAL ($\mu g.m^{-3}$)	AC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as a % of the AQS/EAL	Significance
NO_2	1 Hour 99.79th percentile	200	52	76.0	38.0	Negligible
	Annual	40	26	26.0	65.1	Negligible
CO	1 Hour Max	10,000	237.4	288.3	2.9	Negligible
	Annual	350	118.7	118.8	33.9	Negligible
HCl	1 Hour Max	750	0.74	4.5	0.6	Negligible
	Annual	20	0.37	0.4	1.9	Negligible
HCN	1 Hour Max	220	-	-	n/a	n/a
$COCl_2$	1 Hour Max	25	-	-	n/a	n/a
	Annual	0.8	-	-	n/a	n/a
CH_3OH	1 Hour Max	33300	-	-	n/a	n/a
	Annual	2660	-	-	n/a	n/a
F_2	1 Hour Max	2.8	-	-	n/a	n/a
	Annual	1	-	-	n/a	n/a
CH_2O	1 Hour Max	100	-	-	n/a	n/a
	Annual	5	-	-	n/a	n/a

Notes: PEC is calculated by taking the PC from Table 10-25 and adding it to the ambient concentration (AC)

Table 10-27: Contained Firing Process Contributions (PC) to Ground Level Concentrations

Pollutant	Averaging Period	AQS/EAL ($\mu g.m^{-3}$)	PC ($\mu g.m^{-3}$)	PC as a % of the AQS/EAL	Magnitude
CO	1 Hour Max	10,000	0.78	0.01	Extremely Small
	Annual	350	0.001	3.6×10^{-4}	Extremely Small
HCl	1 Hour Max	750	10.0	1.33	Extremely Small
	Annual	20	0.01	0.06	Extremely Small
HF	1 Hour Max	160	13.3	5.33	Extremely Small
HCN	1 Hour Max	220	6.2	2.82	Extremely Small

Table 10-28: Contained Firing Predicted Environmental Concentration (PEC)

Pollutant	Averaging Period	AQS/DEEAL ($\mu g.m^{-3}$)	AC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as a % of the AQS/DEEAL	Significance
CO	1 Hour Max	10,000	237.4	238.2	2.4	Negligible
	Annual	350	118.7	118.7	33.9	Negligible
HCl	1 Hour Max	750	0.74	10.7	1.4	Negligible
	Annual	20	0.37	0.4	1.9	Negligible
HF	1 Hour Max	160	4.92	18.2	7.3	Negligible
HCN	1 Hour Max	220	-	-	n/a	n/a

The maximum values reported in the above tables show that all the relevant AQS objectives and EALs are predicted to be achieved. The greatest increase is predicted in 1-hour NO_2 concentrations. However, even when this is added to double the annual background value used in this assessment (26 $\mu g.m^{-3}$ x 2 = 52 $\mu g.m^{-3}$) maximum 1-hour mean concentrations are predicated to be well below the 200 $\mu g.m^{-3}$ AQS objective, Table 10-26. The magnitude of increase is considered to be a 'very small' increase in short-term NO_2 concentration and therefore to be of 'negligible' significance based on the criteria adopted for this assessment.

Maximum annual mean concentrations of NO_2 are also predicted to be well below the annual AQS objective with the magnitude of effect considered to be 'extremely small' and the significance to be 'negligible'.

The predicted magnitude of effect for all other pollutants considered is 'extremely small' in comparison to the relevant AQS objectives and EALs with the significance of the increase considered to be 'negligible'.

This assessment has been undertaken on the basis that emissions from the 10 firings typically undertaken at the Hydrus Facility coincide with worst-case meteorological conditions. This assessment has predicted that all AQS objectives and relevant EALs will be achieved for all pollutants considered.

Radiological Impacts

The Manor House Hotel has been identified as the key receptor due to its proximity within 300 metres of the Hydrus Development Site. Maximum predicted effective doses to the identified critical group were less than 1×10^{-14} Sv per year ($<10^{-8}$ µSv per year), in the 50th year of discharges, for all age groups (infants, children and adults).

This is many orders of magnitude below the dose level of 20 µSv per year below which doses are deemed not to be of regulatory concern, subject only to establishing Best Practicable Means in limiting discharges (Cmnd 2919, 1995).

Additional dose assessment modelling has been undertaken by AWE for receptors within 1 km of the Hydrus Development Site, presented in Table 10-29. These values support the BPM/ALARP argument for the Hydrus Facility and shows that the radiological dose associated with the site is significantly less than the public dose target. The significance of these emissions is 'negligible' according to the significance criteria adopted for this assessment.

Table 10-29: AWE Public Dose Assessment (μSv.hr^{-1}) *within 1 km*

Pollutant	Test	Public Dose Target	PC at 1 km	PC as a % of the Public Dose	Magnitude
Depleted Uranium	Open	0.2	1.75×10^{-8}	8.75×10^{-6}	Extremely Small
Depleted Uranium	Contained	0.2	6.74×10^{-12}	3.37×10^{-9}	Extremely Small
Plutonium	Contained	0.2	3.11×10^{-7}	1.56×10^{-4}	Extremely Small

These calculations take into account current test facility which will be replaced by the Proposed Development. As such the assessment of radiological emissions is conservative.

10.5.2 Mitigation Measures

10.5.2.1 Construction

Construction Dust

The AWE Construction Management Department is responsible for the management and delivery of the construction phase of major projects at AWE Aldermaston. AWE will have overall responsibility during all stages of construction to ensure that all construction activities are in compliance with the Code of Construction Practice (CoCP), AWE Construction Site Rules, and statutory and consent obligations.

The AWE CoCP, submitted as a supporting document to the planning application, explains the overall approach of AWE to manage and control environmental impacts arising from construction activities. The CoCP explores a range of adverse environmental impacts which may occur during construction, including:

- Access and traffic management;
- Solid waste;
- Liquid waste;
- Atmospheric emissions;
- Resource use;
- Land and groundwater;
- Ecology and heritage;
- Nuisance;
- Landscape and visual impact; and
- Workforce and local employment opportunities.

Control measures which address these potential impacts are proposed within the CoCP that meet AWE's internal standards as well as addressing the requirements of the local authorities.

Prior to construction, contractors are required to produce a Safe System of Work (SSoW) statement, which will include a method statement and an environmental risk assessment. During construction, the environmental control measures set out in the CoCP will be implemented through the Contractors' Construction Environment, Safety and Health (ESH) Plans and Project Register of Environmental Aspects (PREA). In addition, requirements for contractors are contained within the AWE Construction Site Rules (CSR). The contractor has responsibility to fulfil any statutory obligations regarding environmental legislation.

In order to reduce the risk of pollution, plant and equipment will be continuously maintained in accordance with the manufacturer's specifications. In addition, plant and equipment will be located away from sensitive receptors and residential areas on or near to the Hydrus Development Site. The AWE CoCP provides guidance on reducing air pollution, such as using low emission fuels where possible, and not leaving plant running unnecessarily.

Throughout all phases of construction a 'good housekeeping' policy will be applied, as outlined in the AWE CoCP. All work areas will be kept tidy and road surfaces will be kept clean and in a good condition. Relevant dust suppression measures and controls will be employed on the Application Site to minimise airborne dust as set out below:

Materials Storage and Handling

- Materials handling and storage areas will be sited as far away as reasonably practicable from public/residential areas. These areas will be actively managed where practicable. Prolonged storage of debris on site will be avoided.
- Handling areas will be kept as clean as practicable to avoid nuisance from dust.
- Where appropriate Monoflex sheeting will generally be added to the side of scaffolding to prevent dust blowing off completed floorplates.
- Where necessary, other dusty materials will be dampened down using water sprays in dry weather.
- Volatile materials will be kept in sealed containers and kept cool for as long as possible.
- Hot bituminous material will be transported in a covered container and bitumen will be heated to the minimum temperature to minimise volatile organic compound release.

Construction Plant

- Site plant and equipment will be kept in good repair and maintained in accordance with the manufacturer's specifications.
- Where practicable, low emission fuels will be employed for construction plant. No plant will be left running when not in use.
- Any fixed plant and equipment will be located away from sensitive receptors and residential areas near the site.
- Where necessary fencing/enclosures will be erected around major construction plant items.
- Plant with dust arrestment equipment (such as particle traps) will be used where practicable.

Vehicle Movements

- Effective wheel cleaning will be undertaken for traffic leaving the construction sites onto site haul/public highways by the use of wheel washes. Road sweepers and vacuum sweepers will be used to maintain such roads in a clean condition.
- During prolonged dry periods or as directed by the site manager, haul roads will be dampened down where practicable
- All site vehicles will be kept in a good state of repair and maintenance.
- All vehicles carrying dusty materials into or out of the site will be sheeted to prevent escape of materials.

Operational Control

- Site operations will be planned to take into account local topography, prevailing wind patterns and local sensitive receptors.
- Burning of materials on site will be prohibited.
- Loading and unloading will only be permitted on designated areas.
- Appropriate dust controls will be employed for the demolition work, including sheeting, use of enclosed rubble shutes, etc.
- Dust controls for 'special operations' will be specified as part of the risk assessment e.g. cutting or grinding of stone or metalwork, sandblasting or other similar cleaning, and crushing.
- Immediate clean up of spillage will be employed.
- Completed earthworks will be sealed or planted as early as practicable.
- Where parts of the site have been identified as potentially contaminated, any necessary precautions indicated by risk assessments will be specified for dust control, spoil removal and disposal.
- All substances used in refrigeration, air conditioning and heat pump equipment will be recaptured for reuse, recycling or reclamation before the dismantling or disposal of equipment. Captured gas not intended for re-use will be disposed of to a licensed recovery or disposal facility by qualified experienced refrigerant engineers.

Monitoring

- Monitoring on a visual basis will be undertaken regularly to enable proactive management of dust. Wind speed and direction will be included in the monitoring.
- Dust complaints will be investigated at the earliest opportunity and appropriate action taken to control the source or remedy the effect as appropriate.
- AWE will provide access to all records of dust monitoring for dissemination as appropriate.

Construction Traffic

Mitigation is not required for off-site movements of construction traffic associated with the development, as maximum air quality effects are predicted to be of 'negligible' significance according to the criteria adapted for this assessment, with all predicted concentrations well below the relevant AQS objectives. On-site controls are set out in the preceding construction dust mitigation section.

10.5.2.2 Operational

Operational Traffic

The Proposed Development will not result in an increase of road traffic flows on the local network, as such no mitigation measures are required.

Hydrus Stack Emissions

Additional mitigation over and above the controls incorporated into the design of the scheme is not required for the completed development. This is because maximum air quality impacts are predicted to be of 'slight adverse' significance according to the criteria adopted for this assessment and all ground-level concentrations are predicted to be well below the relevant AQS objectives and EAL's.

The overall impact from the proposed Hydrus Facility is 'slight adverse', however, the proposed scheme will replace the existing test facility on the AWE Aldermaston Site. As such any emissions from the proposed Hydrus Facility will be offset once the firings move from the existing facility. On this basis the overall impact of the proposed scheme is considered to be negligible based on professional judgement.

10.6 Residual Impact Assessment and Conclusions

Table 10-27 summarises the effects identified in the air quality assessment.

Table 10-27: Summary of Effects

Potential Impacts / Known Receptors	Mitigation	Nature of Impact	Scale	Significance of Residual Impact
Construction Dust/ Residential Dwellings	Follow CoCP	Direct / Reversible	Local	Negligible
Construction Traffic Emissions / Residential Dwellings	None Required	Temporary/ Reversible	Local	Negligible
Hydrus Emissions / Residential Dwellings	None Required	Direct / Reversible	Local	Negligible

No significant long-term residual impacts are expected. Temporary residual effects would occur during the construction phase of the Proposed Development, and from emission during the operational phase. However, all impacts are predicted to be below the relevant AQS objectives and EALs.

All discharges are mitigated through the use of modern techniques and comply with modern standards as assessed following ALARP, BPM and BAT. The Proposed Development is a purpose built facility, and discharges will be less than current discharge levels due to modern systems and controls. The new Hydrus Facility will replace the existing research facility and as such should represent a benefit in terms of air quality.

Overall, the Proposed Development is not predicted to have significant air quality effects at any sensitive receptors.

10.7 Cumulative Impact Assessment

The AWE Aldermaston & Burghfield Site Development Context Plan (SDCP08) 2000–2015 (Ref. 10-40) sets out the overall approach to the modernisation of AWE Aldermaston and AWE Burghfield (approximately 8.5 km to the northeast of the Application Site), through the refurbishment and replacement of existing facilities.

The SDCP08 describes a number of proposals for new buildings at the AWE Burghfield and AWE Aldermaston Sites, plus demolition or refurbishment of existing buildings.

Due to the distance between AWE Burghfield and AWE Aldermaston, construction activities within the respective site boundaries will not cause a significant cumulative impact on air quality at sensitive receptors.

It is possible that traffic associated with construction activities will share a portion of the major transport routes as they approach AWE Aldermaston. The air quality effects associated with these vehicle movements are considered to be insignificant compared to that associated with base traffic flows along these major routes.

It is important to note that for both AWE Aldermaston and AWE Burghfield, it is expected that the implementation of the programme outlined in the SDCP08 will not lead to levels of employment greater than those already associated with the sites. Traffic levels will not lead to significant cumulative air pollution impacts at receptors in the vicinity of the two sites.

10.8 References

Ref. 10-1 Council Directive 1996/62/EC of 27 September 1996 on ambient air quality assessment and management

Ref. 10-2 Council Directive 2008/50/EC of 21May 2008 on ambient air quality and cleaner air for Europe

Ref. 10-3 Department for Environment, Food and Rural Affairs (Defra), (2007), The Air Quality Standards (England) Regulations

Ref. 10-4 Department for Food and Rural Affairs (DEFRA), (2007): The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1).

Ref. 10-5 Department for Food and Rural Affairs (DEFRA), (2000): The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Working Together for Clean Air

Ref. 10-6 Department for Food and Rural Affairs (DEFRA), (2002): The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Addendum

Ref. 10-7 Environment Agency (2008) Horizontal Guidance Note EPR H1: Environmental Risk Assessment, Assessment of Point Source Releases and Cost-benefit Analysis, version 080328.

Ref. 10-8 Department for Environment, Food and Rural Affairs (Defra),(2009), Local Air Quality Management Technical Guidance LAQM.TG(09)

Ref. 10-9 Office of the Deputy Prime Minister (OPD); (2004); Planning Policy Statement 23 (PPS23):Planning and Pollution Control.

Ref. 10-10 Regional Spatial Strategy for the South of England (2009): The South East Plan.(SEERA).

Ref. 10-11 Berkshire Structure Plan 2011-2016

Ref. 10-12 West Berkshire Local Plan (adopted June 2002)

Ref.10-13 Basingstoke and Deane Borough Council (June 2009) Local Plan 1996-2011 Schedule of Saved Policies

Ref. 10-14 Radioactive Substances Act 1993, Chapter 12. http://www.opsi .gov.uk/ACTS/acts1993/pdf/ukpga_19930012_en.pdf

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Ref. 10-16 Mayor of London (2006) The Control of Dust and Emissions from Construction and Demolition, Best Practice Guidance.

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Ref. 10-19 Air Quality Consultants on behalf of Department for Environment, Food and Rural Affairs, (2003): 'Analysis of the Realstionship Between 1-hour and Annual mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites'

Ref. 10-20 Department for Food and Rural Affairs (DEFRA), (2007): the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 2).

Ref. 10-21 National Society for Clean Air (2006), Development Control: Planning for Air Quality

Ref. 10-22 United States Environmental Protection Agency 2004. AERMOD: Description of Model Formulation. EPS-454/R-03-004

Ref. 10-23 Environment Agency, March 2008. EPR H1, Environmental Risk Assessment Part 2. Assessment of point source releases and cost-benefit analysis.

Ref. 10-24 Air Quality Updating and Screening Assessment for Basingstoke and Deane. August 2003

Ref. 10-25 Basingstoke and Deane Borough Council Air Quality Review and Assessment Progress Report 2004

Ref. 10-26 Basingstoke and Deane Borough Council Air Quality Review and Assessment - Detailed July 2005

Ref. 10-27 Air Quality Updating and Screening Assessment for Basingstoke and Deane. June 2006

Ref. 10-28 Basingstoke and Deane Borough Council Air Quality Review and Assessment Progress Report July 2007

Ref. 10-29 Basingstoke and Deane Borough Council Air Quality Review and Assessment Progress Report April 2008

Ref. 10-30 West Berkshire Council Local Air Quality Management Air Quality Updating and Screening Assessment - Final Report May 2003

Ref. 10-31 West Berkshire Council Local Air Quality Management Air Quality Review & Assessment - Progress Report April 2004

Ref. 10-32 West Berkshire Council Local Air Quality Management Air Quality Review & Assessment - Progress Report August 2005

Ref. 10-33 West Berkshire Council Local Air Quality Management Updating and Screening Assessment 2006. January 2007

Ref. 10-34 West Berkshire Council Local Air Quality Management Detailed Assessment July 2008

Ref. 10-35 West Berkshire District Council Air Quality Management Order 2009

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Ref. 10-38 Defra (2005), Expert Panel on Air Quality Standards: guidelines for halogen and hydrogen halides in ambient air for protecting human health against acute irritancy effects. Draft consultation document.

Ref. 10-39 UK National Air Quality Information Archive, www.airquality.co.uk

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