



**Air Quality Assessment
Short Term Operating
Reserve (STOR) Facility
Burghfield, Reading**

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Enso Energy Ltd

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1. Introduction

1.1 Purpose of the Assessment

Gair Consulting Ltd has been commissioned by Enso Energy to undertake an assessment of potential local air quality impacts associated with the proposed development of a Short Term Operating Reserve (STOR) facility at a site to the southwest of Reading (Figure 1.1). The site is located to the south of Southcote (off Burghfield Road). It is located within the administrative area of Reading Borough Council (RBC) but the administrative area of West Berkshire Council (WBC) lies to the immediate south and west of the site.

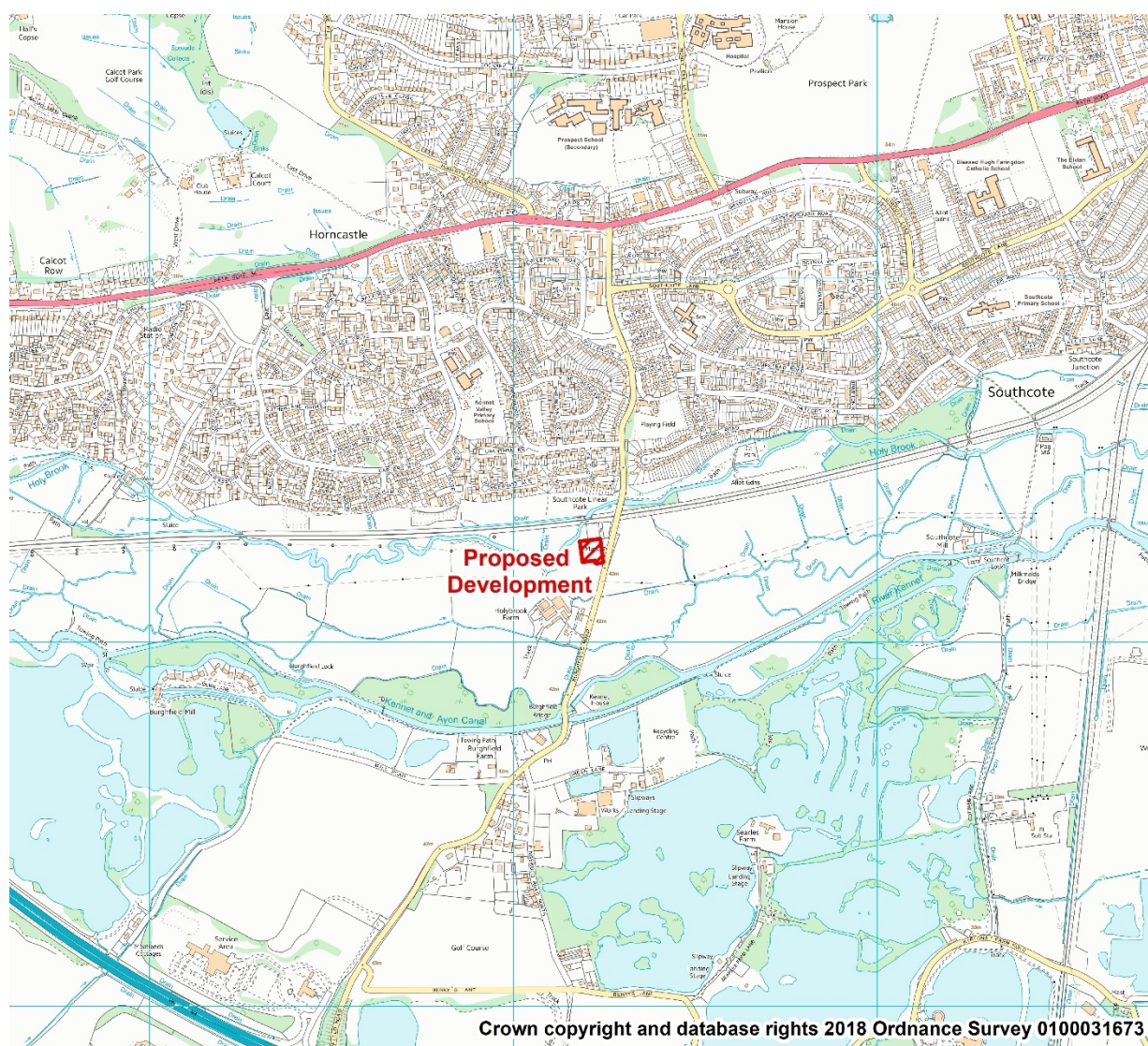


Figure 1.1: Site Location

An increasing proportion of electricity generating capacity is coming from renewable sources. Therefore, in order to manage short term fluctuations in demand and supply, the national grid has access to a

number of reserve power generators, which can be used at short notice to cover any gaps in demand and supply.

The STOR facility at Burghfield Road comprises of twenty generating units with a total electricity generating capacity of 20 MWe. It is proposed that the generating units would be used for up to 2,000 hours per annum during periods of high demand. Generally, these would be at peak demands during the winter and during the hours 07:00 to 11:00 and 15:00 to 20:00 but the facility could operate at any time of the day or night.

1.2 Scope of the Assessment

The impact of dust generated during the construction phase of the proposed STOR facility has the potential to give rise to off-site annoyance and health impacts associated with fine particles. Therefore, the impact of construction activities has been assessed using the methodology described by the Institute of Air Quality Management (IAQM) in their Construction Dust Guidance¹.

Guidance is provided by IAQM and Environmental Protection UK (EPUK)² on indicative criteria for requiring a traffic-related air quality assessment in their land-use planning development control: planning for air quality (January 2017). For sites that are not located within an air quality management area (AQMA), these are 500 light duty vehicles (LDVs) annual average daily traffic (AADT) and/or 100 HGVs. Where there is an AQMA this is reduced to 100 LDVs and 25 HDVs as the AADT. The numbers of vehicles associated with construction are not predicted to be significant in terms of total emissions or construction duration. The proposed STOR facility would be run automatically, with intermittent maintenance visits. Therefore, on the basis of the IAQM/EPUK screening criteria, it is concluded that a detailed assessment of the impact of traffic associated with the development is not required.

Principal emissions from the STOR facility include the oxides of nitrogen (NO_x) and carbon monoxide (CO) which have the potential to affect human health. Therefore, these have been included in the air quality assessment. Emissions of NO_x also have the potential to affect habitats sites. There is one European habitat site within 10km of the proposed development and a number of Ancient Woodlands within 2 km. Therefore, the impact of emissions from the generating units on sensitive habitats has also been considered. The assessment of operational impacts has been undertaken taking into consideration the Position Statement issued by the IAQM relating to short term operating reserve (STOR) facilities³.

1 Guidance on the Assessment of Dust from Demolition and Construction, Institute of Air Quality Management (June 2016)

2 Land-Use Planning & Development Control: Planning for Air Quality, EPUK and IAQM (January 2017)

3 Assessment of Air Quality Impacts from STOR facilities and other limited-hours-of-operation plant, Position Statement, IAQM Interim Statement for Consultation (September 2017)

There is the potential for odours to be released from the generating units. Odours can include fugitive releases of natural gas containing odorous compounds or the presence of odorous volatile organic compounds in the exhaust gases due to incomplete combustion of the gas particularly at start-up. However, fugitive releases of gas would be extremely rare and the duration of start-ups would be short. Therefore, it is considered that the facility would have a negligible impact on off-site odour and has been screened out of the assessment.

Therefore, the potential air quality impacts arising from the construction and operation of the STOR facility are as follows:

- construction activities giving rise to dust and airborne particles; and
- emissions to air from the operation of the generating units.

1.3 Structure of the Report

The remainder of this report is presented as follows:

- Section 2 presents an assessment of baseline conditions for the air quality assessment.
- Section 3 provides a description of the assessment methodology for the air quality assessment.
- Section 4 provides an assessment of construction dust impacts on local air quality.
- Section 5 presents an assessment of the operational impact of emissions on human health and local air quality.
- Section 6 presents an assessment of the operational impact of emissions on sensitive habitat sites.
- Section 7 summarises and concludes the air quality assessment.

2. Baseline Conditions

2.1 Introduction

This section of the report defines the baseline environment for the assessment and provides the following:

- a discussion of appropriate ambient air quality assessment criteria;
- a review of background monitoring data for the local area; and
- a description of local conditions that will affect the dispersion and dilution of emissions arising from the proposed development.

In relation to impacts on humans, the pollutants of interest emitted from the generating units are the products of combustion (NO_x and CO). The construction of the development may also give rise to fine particles (referred to as PM₁₀).

2.2 Assessment Criteria

Oxides of Nitrogen (NO_x)

The oxides of nitrogen comprise principally of nitric oxide (NO) and nitrogen dioxide (NO₂). The oxides of nitrogen (NO_x) in combustion processes may be formed from the oxidation of nitrogen in the fuel or from the reaction of nitrogen and oxygen at high temperatures. The majority of NO_x is emitted from combustion processes as NO (typically over 90%), a relatively innocuous substance that rapidly oxidises to NO₂ in ambient air. Health based standards for NO_x generally relate to NO₂.

A new Directive (2008/50/EC of the European Parliament and of the Council of 21st May 2008, on ambient air quality and cleaner air for Europe) was adopted in June 2008. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Directives within a single, integrated instrument.

Directive 2008/50/EC retains the existing air quality standards for NO₂ but provides greater clarity on where to assess air quality, so that the focus is on areas of potential public exposure. The Directive has been transposed into the UK Air Quality Standards Regulations 2010, which came into force on the 11th June 2010.

Air quality limits and objectives for the oxides of nitrogen in the UK are summarised in Table 2.1.

Table 2.1 Air Quality Objectives and Limit Values for Nitrogen Dioxide

Set In 2010 UK Regulations? (a)	Description	Averaging Period	Value (µg m ⁻³)
Air Quality Strategy (b)			
Yes	Objective for the protection of human health	1-hour mean, not to be exceeded more than 18 times a year (c)	200
		Annual mean	40
EC Directive on Ambient Air Quality (d)			
Yes	Limit Value	1-hour mean, not to be exceeded more than 18 times a year (c)	200
		Annual mean	40

(a) Air Quality Standards Regulations 2010, (SI 2010/2001) Environmental Protection

(b) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007

(c) This corresponds to the 99.8th percentile of hourly means

(d) Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe.

Carbon Monoxide

Air quality limits and objectives for CO are summarised in Table 2.2.

Table 2.2 Air Quality Objectives and Limit Values for Carbon Monoxide

Set In 2010 UK Regulations? (a)	Description	Averaging Period	Value ($\mu\text{g m}^{-3}$)
Air Quality Strategy (b)			
Yes	Objective for the protection of human health	Maximum daily running 8-hour mean	10,000
EC Directive on Ambient Air Quality (c)			
Yes	Limit Value	Maximum daily running 8-hour mean	10,000

(a) Air Quality Standards Regulations 2010, (SI 2010/2001) Environmental Protection

(b) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007

(c) Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe.

Fine Particles (PM_{10})

Air quality standards for particulate matter generally refer to particles of less than 10 micrometres in diameter, termed PM_{10} and particles of less than 2.5 micrometres in diameter, termed $\text{PM}_{2.5}$. The smaller fraction ($\text{PM}_{2.5}$) is generally associated with combustion emissions, particularly solid and liquid fuels. In

relation to construction impacts, PM₁₀ is a more appropriate metric. Current air quality objectives and limit values for PM₁₀ applicable to the assessment are summarised in Table 2.3.

Table 2.3 Air Quality Objectives and Limit Values for PM ₁₀			
Pollutant	Description	Averaging Period	Value (µg m ⁻³)
Air Quality Standards (a)			
Fine Particles (PM ₁₀)	Objective for the protection of human health	24-hour mean, not to be exceeded more than 35 times a year (b)	50
		Annual mean	40
Directive on Ambient Air Quality (c)			
Fine Particles (PM ₁₀)	Limit Value	24-hour mean, not to be exceeded more than 35 times a year (b)	50
		Annual mean	40

(a) Air Quality Standards Regulations 2010
(b) This corresponds to the 90.4P^{thp} percentile of 24-hour means.
(c) Directive 2008/50/EC of the European Parliament.

Critical Levels for the Oxides of Nitrogen

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals. High concentrations of pollutants in ambient air directly cause harm to leaves and needles of forests and other plant communities.

The 2008 Air Quality Directive set limit values for the protection of vegetation and ecosystems and these have been adopted by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (July 2007), but are not currently set in Regulations. The current critical levels, limit values and objectives are summarised in Table 2.4.

Table 2.4 Critical Levels, Limit Values and Objectives for the Protection of Vegetation and Ecosystems

	Description	Averaging Period	Value ($\mu\text{g m}^{-3}$)
Nitrogen Oxides			
Air Quality Strategy (a)	Objective	Annual mean	30
EU Directive on Ambient Air Quality / 2010 Air Quality Standards Regulations (b) (c)	Critical Level / Limit Value	Annual mean	30
Environment Agency Risk Assessment Guidance	Critical Level (d)	Daily mean	75
Air Quality Strategy (a)	Objective	Annual mean	30

(a) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007

(b) Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008

(c) The Air Quality Standards Regulations 2010, SI 1001 Environmental Protection.

(d) WHO (2000) Air Quality Guidelines for Europe, 2nd Edition, WHO Regional Publications, European Series No. 91.

The critical levels for NO_x prescribed in the Air Quality Regulations are based on monitoring criteria for the EU limit values and only apply in the following areas:

- more than 20 km from agglomerations; and
- more than 5 km away from other built up areas, industrial installations, motorways and major roads with a traffic count of more than 50,000 vehicles per day.

The deposition of pollutants to soils and plant surfaces can also adversely affect habitat sites and critical loads are provided for assessing the impact of nitrogen deposition and acidification. These are site and habitat specific and discussed in more detail in Section 6.1.3.

2.3 Local Conditions

The Dispersion and Dilution of Emissions

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. In the UK, all of these sites are quality controlled by the Met Office.

The most important climatological parameters governing the atmospheric dispersion of pollutants are as follows:

- Wind direction determines the broad transport of the emission and the sector of the compass into which the emission is dispersed.
- Wind speed will affect low level emissions by increasing the initial dilution of pollutants in the emission.

- Atmospheric stability is a measure of the turbulence, particularly of the vertical motions present.

Local Wind Climate

Met Office observing stations are limited and the nearest station to the site with full data suitable for dispersion modelling is located at RAF Benson, approximately 20 km to the north of the proposed development. Five years of meteorological data for this observing station have been obtained (2012 to 2016) and a wind rose for the five years is presented in Figure 2.1.

The predominant wind directions are from the south (12.8%) and south-southwest (11.0%), calm winds occur for 1.4% of the time.

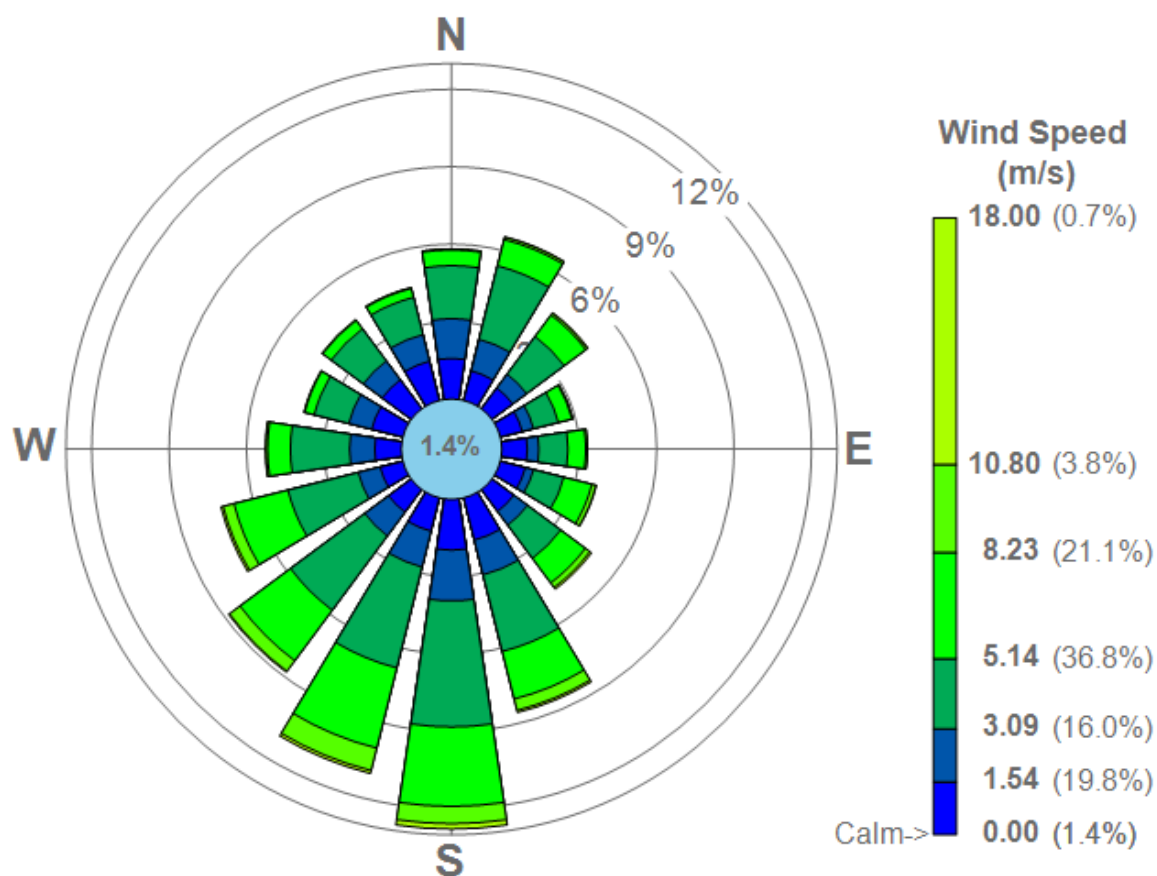


Figure 2.1: Wind Rose for RAF Benson for 2012 to 2016

2.4 Background Air Quality

Local Authority Review and Assessment

Local authorities are required to periodically review and assess the current and future quality of air in their areas. Where it is determined that an air quality objective is not likely to be met within the relevant time period, the authority must designate an Air Quality Management Area (AQMA) and produce a local action plan.

The proposed development is located within the Reading Borough Council (RBC) administrative area but the West Berkshire Council (WBC) administrative area is immediately to the west of the site. The most recent air quality management and review reports available from RBC and WBC are the Air Quality Annual Status Reports (ASR) for 2017 ⁴ for RBC and 2016 for WBC⁵.

Reading Borough Council has declared one AQMA within their administrative area which covers an area encompassing all the main arterial routes in and out of Reading and the central area. This has been declared for annual mean NO₂ and 24-hour PM₁₀. West Berkshire Council has declared two AQMA within their administrative area. These are located within Newbury and Thatcham and at a distance of over 15 km from the site would not be affected by the development. These have both been declared for annual mean NO₂ concentrations and for hourly concentrations of NO₂ for the Newbury AQMA. The Reading AQMA is located less than 1 km from the development site. Therefore, the impact of emissions from the proposed development on the AQMA should be assessed.

RBC currently operates three automatic ambient air quality monitoring sites within their administrative area. In addition, there is an Automatic Urban and Rural Network (AURN) monitoring site operated by Defra within Reading. The council also has an extensive network of diffusion tubes monitoring sites within the borough. WBC currently operates one automatic ambient air quality monitoring site within their administrative area. The council also has an extensive network of diffusion tube monitoring sites.

Background Pollutant Concentrations

Nitrogen Dioxide

The three RBC monitoring sites are all roadside locations and would not be representative of local air quality at the development site. The AURN monitoring site is 5.5 km to the east of the site and again unlikely to be representative of the development site but as an urban background site may provide an indication of urban background concentrations within the area. Monitoring data for the last three years are summarised in Table 2.5. For the three years, the average NO₂ concentration at the AURN site is

⁴ 2017 Air Quality Annual Status Report (ASR) for Reading Borough Council (June 2017)

⁵ 2016 Air Quality Annual Status Report (ASR) for West Berkshire Council (August 2016)

27.7 $\mu\text{g m}^{-3}$. There were four exceedences (18 are allowed) of the 1-hour AQO in 2016 but none in 2014 or 2015.

Table 2.5 Measured NO₂ Concentrations at Reading ($\mu\text{g m}^{-3}$)

Site Name	2014	2015	2016
Reading New Town	27	22	34

The majority of the diffusion tube sites are roadside locations and will not be entirely representative of the site. The nearest location is on Bath Street approximately 1 km to the north. For the last three years that data are available (2014 to 2016) concentrations ranged between 29 and 31 $\mu\text{g m}^{-3}$ with a mean of 30 $\mu\text{g m}^{-3}$.

WBC have two diffusion tube monitoring sites to the west of Reading and a summary of measured concentrations for the three most recent years are presented in Table 2.6. The Langley Hill monitor is an urban background site at a distance of 13 m from the kerbside whereas the Calcot Hotel monitoring site is a kerbside location at distance of 2 m from the kerb. For the three years, the average NO₂ concentration is 25.2 $\mu\text{g m}^{-3}$ and 32.3 $\mu\text{g m}^{-3}$ for the urban background and kerbside sites, respectively.

Table 2.6 Measured NO₂ Concentrations at within West Berkshire ($\mu\text{g m}^{-3}$)

Site Name	2013	2014	2015
102 Langley Hill, Tilehurst	28.1	25.9	21.7
Calcot Hotel, A4 Bath Road, Calcot	36.9	34.6	25.3

In addition to local monitoring data, information on background NO₂ concentrations has been obtained from the Defra UK Background Air Pollution Maps ⁶. These 1 km grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites. For NO₂, mapped data for the nine 1 km² grids around the site have been obtained. Annual mean concentrations for the development site range between 12.0 and 16.1 $\mu\text{g m}^{-3}$ with an average of 13.3 $\mu\text{g m}^{-3}$.

For the purposes of the assessment, it is assumed that the annual mean NO₂ concentration at the roadside is 27.7 $\mu\text{g m}^{-3}$ as the average of urban background at Reading New Town. For non-roadside

⁶ <https://uk-air.defra.gov.uk/data/laqm-background-home>

receptors, the annual mean NO₂ concentration is assumed to be 16.1 µg m⁻³ (maximum of the Defra background mapping data).

Carbon Monoxide

There is no continuous automatic monitoring of CO within the RBC administrative area. Therefore, ambient background concentrations of CO for 2018 have been obtained from the Defra UK Background Air Pollution Maps. For CO, mapped data for the nine 1 km² grids around the site have been obtained. Mapped background data for CO is not available for the recent mapping data published in 2017 and the 2001 mapping data has been used and data has been projected to 2018 using a factor of 0.435.

For CO, mapped data for the nine 1 km² grids around the site have been obtained. The maximum annual mean CO concentration for these nine 1 km² grids is 182 µg m⁻³ and this is assumed to be the annual mean background CO concentration at the development site.

Fine Particles (PM₁₀ and PM_{2.5})

RBC carry out automatic monitoring of PM₁₀ at all of the continuous monitoring sites. PM₁₀ monitoring is also undertaken at the Defra AURN urban background site. For the last three years (2014 to 2016), measured annual mean concentrations at the AURN site varied between 12 and 14 µg m⁻³ with a mean of 13 µg m⁻³. There were three exceedences (35 are allowed) of the 24-hour AQO in 2016 but none in 2014 or 2015.

Ambient background concentrations of PM₁₀ for 2018 have also been obtained from the Defra UK Background Air Pollution Maps. Annual mean concentrations of PM₁₀ for the development site range between 12.5 and 13.5 µg m⁻³ with an average of 12.9 µg m⁻³ and are well below the air quality objective of 40 µg m⁻³. As a worst-case it is assumed that the background PM₁₀ concentration is 14.0 µg m⁻³ (maximum measured urban background concentration).

Summary of Background Concentrations

A summary of the annual mean background concentrations that have been used in the assessment is presented in Table 2.5. Short-term concentrations have been derived based on guidance provided by the Environment Agency (EA) in their guidance on 'risk assessment for your environmental permit'.

Table 2.5 Summary of Background Concentrations for the Assessment

Pollutant	Averaging Period	Urban Background Concentration (µg m ⁻³)	Roadside Concentration (µg m ⁻³)
Nitrogen Dioxide (NO ₂)	Annual	16.1	27.7
	1-Hour	32.2 (a)	55.4 (a)
Carbon Monoxide (CO)	Annual	182	364 (d)

	8-Hour	255 (a)(c)	510 (a)(c)
Particles (PM ₁₀)	Annual	14.0	Not required for construction dust assessment
	24-Hour	16.5 (a)(b)	

- (a) 1-hour mean background concentration estimated by multiplying the annual mean by a factor of 2 in accordance with EA Guidance.
- (b) 24-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.59 in accordance with EA Guidance.
- (c) 8 hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.70 in accordance with EA Guidance.
- (d) Assumed to be a factor of two higher than urban background concentrations.

3. Assessment Methodology

3.1 Introduction

Construction dust impacts have been assessed using guidance provided by the IAQM. Emissions to air from the STOR facility have been modelled using the US AERMOD dispersion model (US EPA 16216r) and a five year meteorological data set from the RAF Benson observing station (2012 to 2016).

The IAQM has recently issued an interim position statement for the assessment of air quality impacts from STOR facilities and other limited-hours-of-operation plant ⁷. The IAQM's position on this issue is as follows.

- The IAQM considers that assessment of the impact of emissions from STOR-type plant cannot be disregarded on the basis of limited operating hours. It is also important that emission rate data appropriate to the proposed plant are applied in assessing both long-term and short-term exposure.
- Careful consideration of 'the concentration of the substance that's already present in the environment' (existing baseline ambient concentrations) must be carried out to ensure that the contribution from all local sources near to receptors is appropriately accounted for.
- The EPUK & IAQM's guidance on the assessment of air quality for planning includes an approach for describing impacts. The IAQM's position is that this guidance should also be applied when assessing the impacts of combustion plant that is operated on a limited-hours basis. Therefore, predicted total concentrations that are below the objective level should not automatically lead to conclusions that impacts are 'negligible' and therefore 'not significant'. Instead, the IAQM guidance should be followed and the impact should be assigned an appropriate impact descriptor; this may then show that impacts are not 'negligible' at concentrations below the objective level.

The assessment undertaken for the STOR facility is in accordance with the IAQM's interim position statement.

3.2 Sensitive Receptors

The air quality assessment has considered the impact of emissions from the STOR facility at a number of discrete receptors. The locations of these receptors are provided in Figure 3.1 and described in Table 3.1. The nearest receptors surrounding the STOR facility in all directions have been selected for the assessment. Receptors have been separated into roadside and non-roadside receptors depending on their proximity to major roads. It should be noted that the impact of short-term concentrations is

⁷ Assessment of Air Quality Impacts from STOR facilities and other limited-hours-of-operation plant, Position Statement, IAQM Interim Statement for Consultation (September 2017)

relevant to all sensitive receptors but for non-residential receptors there is no relevant public exposure (NRPE) to annual mean concentrations as receptors are not resident at these locations for long periods of time.

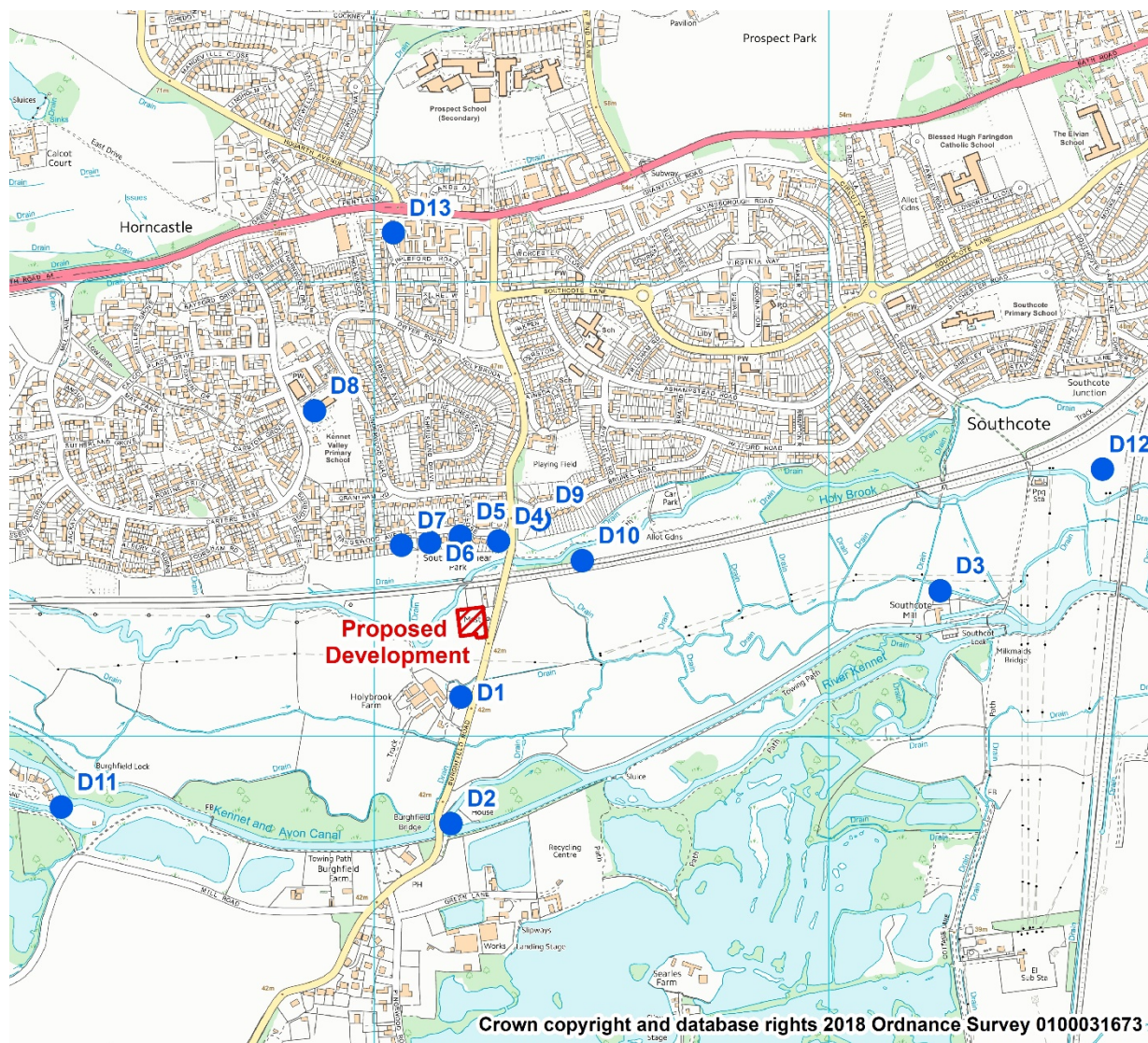


Figure 3.1: Locations of Potentially Sensitive Receptors Considered for the Air Quality Assessment

Table 3.1 Description of Sensitive Receptors for The Air Quality Assessment

Ref.	Name	Type (a)	Grid Reference	
			Easting	Northing
D1	Holybrook Farm	Farm/residential (BG)	468191	171087
D2	Kennet House	Residential (BG)	468169	170808
D3	Southcote Mill	Residential (BG)	469245	171321
D4	Lea Close 1	Residential (BG)	468273	171430
D5	Lea Close 2	Residential (BG)	468189	171440
D6	Lea Close 3	Residential (BG)	468122	171427
D7	Range Wood Avenue	Residential (BG)	468060	171421
D8	Kennet Valley Primary School	School (BG)	467868	171717
D9	Brunel Road	Residential (BG)	468363	171477
D10	Allotment Gardens	Leisure (BG)	468458	171387
D11	Dewe Lane	Residential (BG)	467312	170844
D12	AQMA northeast	Residential (BG)	469602	171588
D13	AQMA north	Residential (R)	468042	172108

(a) Letters in parentheses indicates whether location assumed to be urban background (BG) or roadside (R)

3.3 Sensitive Habitat Sites

The Environment Agency's Risk Assessment guidance ⁸ states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive;
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive; and
- Ramsar Sites designated under the Convention on Wetlands of International Importance.

Within 2 km of the source:

- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- National Nature Reserves (NNR);
- Local Nature Reserves (LNR);
- local wildlife sites (LWS); and
- Ancient Woodland (AW).

⁸ <https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit>

Within 2 km of the proposed site there are four Ancient Woodlands and one LNR. In addition, there is one European site (Hartslock Wood SAC) within 10 km. Therefore, the predicted impact of NO_x emissions from the STOR facility on these habitats has been assessed. For the local wildlife sites (LNR and AW), the impact of airborne NO_x emissions on the habitats has been assessed by reference to critical levels. For the European site the assessment has also considered the impact of nutrient nitrogen deposition and acidification impacts. Details and location of the sites are provided in Table 3.2.

Table 3.2 Description of Habitats Considered for the Air Quality Assessment

Ref.	Name	Grid Reference	
		Easting	Northing
H1	H1 Lousehill Copse LNR	468479	172939
H2	H2 Churchend Copse AW	467216	172543
H3	H3 Curtis's Wood AW	466591	172392
H4	H4 Walker's Shaw AW	468509	169182
H5	H5 Dean's Copse AW	467056	169593
H6	H6 Hartslock Wood SAC	462154	178182

Information on other local wildlife sites within 2 km of the site have not been specifically assessed but the impact of airborne emissions of NO_x on the site and surroundings are assessed against the annual mean and 24-hour critical levels (refer Section 6.4).

3.4 Construction Dust Impacts

The impact of dust generated during the construction phase of the development has been assessed using the methodology described by the Institute of Air Quality Management (IAQM) Construction Dust Guidance⁹.

The most common air quality impacts relating to construction activities are as follows:

- dust deposition, resulting in the soiling of surfaces;
- visible dust plumes, which are evidence of dust emissions;
- elevated PM₁₀ concentrations, as a result of dust generating activities on site; and
- an increase in concentrations of airborne particles and nitrogen dioxide due to exhaust emissions from diesel powered vehicles and equipment used on site (non-road mobile machinery, NRM) and vehicles accessing the site.

⁹ Guidance on the Assessment of Dust from Demolition and Construction, Institute of Air Quality Management, V1.1 June 2016

The risk of dust emissions from a demolition/construction site causing loss of amenity and/or health or ecological impact is related to:

- the activities being undertaken;
- the duration of these activities;
- the size of the site;
- the meteorological conditions (wind speed, direction and rainfall);
- the proximity of receptors to the activities;
- the adequacy of the mitigation measures applied to reduce or eliminate dust; and
- the sensitivity of the receptors to dust.

The IAQM methodology considers four aspects that may give rise to dust emissions:

- demolition of existing structures;
- construction of the new facilities;
- earthworks; and
- 'trackout' of dust on vehicles.

The potential for dust emissions is assessed for each activity that is likely to take place. If an activity is not taking place (e.g. demolition) then it does not need to be assessed. The assessment methodology considers three separate dust impacts as follows:

- annoyance due to dust soiling;
- the risk of health effects due to an increase in exposure to PM₁₀; and
- harm to ecological receptors.

Step 1 of the IAQM Guidance is to screen the requirement for a more detailed assessment. An assessment will normally be required where there is a human receptor within:

- 350 m of the construction site boundary; or
- 50 m of a road used by construction traffic up to 500 m from the site entrance.

For ecological receptors, an assessment will be required where a sensitive habitat site is within:

- 50 m of the boundary of the site; or
- 50 m of a road used by construction traffic up to 500 m from the site entrance.

It should be noted that the criteria are deliberately conservative and detailed assessments are required for most proposed developments, recognising that dust arising from construction activities within urban areas is a significant source of airborne particles.

Where appropriate, the four potential sources of dust and PM₁₀ (demolition, construction, earthworks and track-out) are considered individually, adopting the methodology in the IAQM guidance to assess the

risk of dust annoyance (soiling), adverse impact on human health due to elevated PM₁₀ concentrations and adverse impact on habitat sites from dust deposition.

In Step 2, a site is allocated a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude as small, medium or large; and
- the sensitivity of the area to dust impacts which is defined as low, medium or high sensitivity.

The dust emission magnitude is based on the scale of the anticipated works and example definitions are presented in Table 3.3.

The sensitivity of the area takes account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM₁₀, the local background concentration; and
- site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

The IAQM document provides guidance on the categorisation of receptors into high, medium and low sensitivities for dust soiling, health effects and ecological effects. For dust soiling, the sensitivity of people and their property to soiling will depend on the level of amenity and the appearance aesthetics and value of property. For health effects from exposure to PM₁₀, sensitivity will depend on whether or not the receptor is likely to be exposed over relevant timescales to elevated concentrations over a 24-hour period. For ecological effects, the sensitivity will depend on the type of the habitat designation (e.g. European site, national or local designations) and the sensitivity of the habitat to dust deposition effects.

Table 3.3 Potential Dust Emission Magnitude

Activity	Large	Medium	Small
Demolition	Building volume >50,000 m ³ , potentially dusty construction materials, demolition at above 20 m in height	Building volume 20,000 to 50,000 m ³ , potentially dusty construction materials, demolition height 10-20 m in height	Building volume <20,000 m ³ , material with low potential for dust release, demolition height <10 m
Earthworks	Site area >10,000 m ² , potentially dusty soil type, >10 heavy earth moving vehicles, bunds >8 m in height, total material moved >100,000 tonnes	Site area of 2,500 to 10,000 m ² , moderately dusty soil type, 5-10 heavy earth moving vehicles, bunds 4-8 m in height, total material	Site area <2,500 m ² , low dust potential soil type, <5 heavy earth moving vehicles, bunds <4 m in height, total material moved <20,000 tonnes

		moved 20,000 to 100,000 tonnes	
Construction	Total building volume >100,000 m ³ , on site concrete batching, sandblasting	Total building volume 25,000 to 100,000 m ³ , potentially dusty construction material	Total building volume <25,000 m ³ , material with low potential for dust release
Trackout	>50 outbound HGV movements in any day, potentially dust surface material, unpaved road length >100 m	10-50 outbound HGV movements in any day, moderately dusty surface material, unpaved road length 50 to 100 m	<10 outbound HGV movements in any day, surface material with low potential for dust, unpaved road length <50 m

3.5 Dispersion Modelling of Emissions

The Dispersion Model

The potential impact of emissions from the STOR facility has been assessed using a dispersion model to predict airborne ground level concentrations of pollutants emitted from the generating unit stacks.

The operational impact from the STOR facility emissions has been assessed using the AERMOD dispersion model. This is one of a 'newer generation' of dispersion models which describe the atmospheric boundary layer properties. AERMOD allows for the modelling of dispersion under convective meteorological conditions using a skewed Gaussian concentration distribution. It is able to simulate the effects of terrain and building downwash simultaneously. It can also calculate concentrations for direct comparison with air quality standards or guidelines. It is used extensively in the UK for assessing the air quality impacts of industrial and other polluting processes.

Building Downwash

Structures associated with the operation of the STOR facility may affect the dispersion of emissions from the generating unit stacks. Building downwash effects occur where buildings are greater than one third of the stack height. Details of building structures that have been included in the dispersion model to allow for building downwash effects are presented in Table 3.4. For a stack height of 7 m, buildings in excess of 3 m should be considered. The principal structures are the twenty containers associated with the generating units.

Table 3.4 Buildings Included in the Dispersion Model

Building	Height (m)	X Length (m)	Y Width (m)	Angle (°)
Container 1 to Container 20	3.9	12.7	2.5	261

Grid Size

In addition to assessing the impact of emissions on the discrete receptors identified in Section 3.2, predicted concentrations are calculated across a 4 km by 4 km grid with a 50 m grid resolution and a smaller nested grid of 1 km by 1 km with a grid resolution of 50 m, providing an overall grid resolution of 25 m. These provide data for the entire model domain for the provision of contour plots of predicted concentration.

Significance Criteria

Planning

The Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) 2017 guidance¹⁰ has been used to determine the significance of any impacts. The impact descriptors for individual receptors is presented in Table 3.5.

Table 3.5 Impact Description for Individual Receptors				
Concentration with Development	Percentage Change in Air Quality Relative to the Air Quality Assessment Level (AQAL)			
	1%	2 to 5%	6 to 10%	>10%
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76 to 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 to 102% of AQAL	Slight	Moderate	Moderate	Substantial
103 to 109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

The assessment of significance is principally left to professional opinion and guidance is provided on the factors that need to be considered when judging significance and include the following:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to impacts;
- the worst-case assumptions adopted when undertaking the prediction of impacts; and
- the extent to which the proposed development has adopted best practice to eliminate and minimise emissions.

In relation to short-term impacts, the IAQM/EPUK guidance states:

¹⁰ Land-Use Planning & Development Control: Planning for Air Quality, EPUK and IAQM (January 2017)

‘6.39 Where such peak short term concentrations from an elevated source are in the range 11-20% of the relevant AQAL, then their magnitude can be described as small, those in the range 21-50% medium and those above 51% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. That is not to say that background concentrations are unimportant, but they will, on an annual average basis, be a much smaller quantity than the peak concentration caused by a substantial plume and it is the contribution that is used as a measure of the impact, not the overall concentration at a receptor. This approach is intended to be a streamlined and pragmatic assessment procedure that avoids undue complexity.’

Therefore, the following descriptors for assessing the impact magnitude resulting from short term impacts are applied in this assessment:

- 10% or less: negligible;
- 11-20%: slight;
- 21-50%: moderate; and
- 51% or greater: substantial.

Environmental Permitting

The Environment Agency’s Environmental Management guidance for risk assessments specifies criteria to enable the potential significance of an impact to be determined. For the process contribution (PC), the impact is deemed insignificant if the annual mean PC is less than 1% of the environmental assessment level (EAL) and the short term PC is less than 10% of the EAL. If either of these criteria is exceeded, they are potentially significant and it is then necessary to consider the total predicted environmental concentration (PEC, which is the PC plus the ambient background concentration).

For the annual mean, if the PEC is below 70% of the assessment criterion then it is considered unlikely that an exceedence of the limit will occur and there should be no adverse impact. For short term concentrations, more detailed assessments are required where the short term PC is greater than 20% of the short term standard minus twice the long term background concentration.

Habitat Sites

The Environment Agency’s risk assessment guidance ¹¹ specifies criteria to enable the potential significance of an impact to be determined. For the process contribution (PC), the impact is deemed insignificant if the annual mean PC is less than 1% of the critical level (or air quality objective) and the short term PC is less than 10% of the critical level (or air quality objective). If either of these criteria is

11 <https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit>

exceeded, they are not necessarily significant however, it is then necessary to consider the total predicted environmental concentration or deposition (PC plus the background contribution) as discussed above.

For local wildlife sites (SINCs, SLINC's, NNRs, LNRs and ancient woodland), a process contribution (PC) is considered not significant if:

- the long term PC < 100% of the long-term critical level;
- the short term PC < 100% of the short-term critical level.

Emission Parameters

Details of the emission parameters for the generating units are provided in Table 3.6. To aid dispersion of emissions, the stacks have been grouped into six multi-flue stacks depending on the layout of the site. There are two stacks containing four flues and four stacks containing three flues.

Table 3.6 Summary of the Stack Emissions Data for Dispersion Modelling	
Parameter	1.0 MWe Generating Unit
Number of sources	20 (total of 6 multi-flue stacks)
Stack height (m)	7
Temperature of emission (°C)	322
Actual flow rate (m ³ s ⁻¹)	2.51
Emission velocity at stack exit (m s ⁻¹)	26.1
Normalised flow rate (Nm ³ s ⁻¹) (a)	1.00
Pollutant	Emission Concentration (mg Nm⁻³) (b)
NO _x	250
CO	800
	Emission Concentration (g s⁻¹)
NO _x – annual mean	0.057
NO _x – hourly mean concentrations	0.25
CO	0.80
(a) Reference conditions of 273K, 1 atmosphere, dry and 5% oxygen	
(b) Emission concentrations expressed as mg Nm ⁻³ (at reference conditions)	
(c) Assuming the facility operates for 2,000 hours per year	

For assessing short-term concentrations (hourly and 8-hourly), worst-case emissions have been assumed for the purposes of the modelling assessment and the plant is assumed to be operating at full load, 100% of the time. This is clearly an extreme worst-case but allows for the fact that the plant may be operating during worst-case meteorological conditions. For long-term concentrations (annual mean and 24-hourly mean concentrations), emissions are reduced based on the number of operational hours (assumed to be 2,000 hours per year).

Environment Agency guidance has been used in relation to the input data for the prediction of annual average impacts from an intermittent process. On this basis the model has been run on the assumption that it will operate for the entire year. However, the emissions have been reduced by a factor of 4.4 (8760/2000) in order that the same total mass emission is released that would be the case for only 2,000 hours per year.

Meteorological Data

Dispersion modelling has been carried out for five years of hourly sequential data from the RAF Benson meteorological station. The model utilises hourly meteorological data to define conditions for the dispersion of emissions, transport and diffusion. Predicted concentrations are estimated for each year and the maximum concentration at each receptor is provided. Therefore, predicted concentrations represent the worst-case for the five year period.

Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants in a number of ways. For stack emissions, the presence of elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to an elevated source and reducing concentrations further away.

The area surrounding the proposed STOR facility is gently undulating and may affect the dispersion of emissions from the facility. Therefore, topographical data has been included within the model.

4. Assessment of Construction Dust Impacts

4.1 Introduction

Dust in the community is normally perceived as an accumulated deposit on surfaces such as washing, window ledges, paintwork and other light coloured horizontal surfaces, e.g. car roofs. When the rate of accumulation is sufficiently rapid to cause noticeable fouling, discoloration or staining (and thus decrease the time between cleaning) then the dust is generally considered to be an annoyance. However, the point at which an individual makes a complaint regarding dust is highly subjective.

Smaller particles (less than 10 µm) are of concern due to their potential impact on human health. Particles are also frequently referred to as PM₁₀ (aerodynamic diameter of less than 10 µm), these include the coarse (greater than 2 µm in diameter) and the fine fraction. Particles larger than PM₁₀ are mainly associated with annoyance impacts and tend to be generated by mechanical processes. A large proportion of the particle releases from construction activities will comprise this larger fraction (i.e. larger than PM₁₀), particularly from handling and processing of construction materials. Finer particles may also arise from on-site mobile and fixed construction plant.

Any form of demolition or construction activity has the potential to generate dust emission and thereby cause annoyance or health impacts to people in the vicinity of the site.

4.2 Screening of Impacts

There will be no major structures requiring demolition on the site and the impact of demolition can be screened out of the assessment. There are sensitive human receptors within 350 m of the site boundary and within 50 m of the route used by construction traffic. Therefore, the impact of earthworks, construction and trackout will be required for assessing the impact of construction activities on human receptors.

There are no ecological receptors within 50 m of the boundary of the site and the impact of construction dust on habitats can be screened out of the assessment.

Therefore, the risk assessment has focussed on the following:

- construction activities on human receptors;
- earthworks (soil stripping, ground-levelling, excavation, piling and landscaping) on human receptors; and
- 'trackout' of dust on vehicles on human receptors.

4.3 Description of the Development

The proposed development site is relatively small with an overall area of around 0.4 hectare (ha). It is located to the south of a railway line that runs east-west with residential properties beyond. To the

south, east and west the location is rural. The nearest residential receptors are located 150 m to the north (Lea Close) and a farm to the south at a distance of 135 m.

4.4 Assessment of Impacts

Dust Emission Magnitude

The assessment has considered the overall construction of the development such that any mitigation measures can be focussed where required for each activity. The development is very small and there will be limited earthworks or construction required. Therefore, for earthworks, construction and trackout, activities would be assessed as having a 'small' dust emission magnitude.

For earthworks, construction and trackout the assessment of the potential dust emission magnitude is summarised in Table 4.1.

Table 4.1 Summary of Dust Emission Magnitude			
Demolition	Earthworks	Construction	Trackout
None	Small	Small	Small

Define the Sensitivity of the Area

Dust Soiling

The sensitivity of the area to the potential impacts assessed (dust soiling) have been defined using the IAQM guidance as presented in Table 4.2. Receptors are identified as being of High, Medium or Low sensitivity as follows:

- High – users can reasonably expect to enjoy a high level of amenity or the appearance or aesthetics or value of their property would reasonably be expected to be present continuously. These would include dwellings, museums, car show rooms etc.
- Medium - users would expect to enjoy a reasonable level of amenity but not at the same level as in their home or the appearance, aesthetics or value of their property could be diminished by soiling. People or property would not be expected to be present continuously. Examples include places of work and parks.
- Low – the enjoyment of amenity would not reasonably be expected or property would be expected to diminish in appearance, aesthetics or value and there would be transient exposure. Examples include playing fields, farmland, footpaths and short term car parks.

Table 4.2 Methodology for Assessing the Sensitivity of the Area to Dust Soiling

Phase/ Receptor Sensitivity	No. of Receptors	Distance from Source			
		< 20 m	<50 m	< 100 m	<350 m
High	> 100	High	High	Medium	Low
	10 - 100	High	Medium	Low	Low
	1 - 10	Medium	Low	Low	Low
Medium	> 1	Medium	Low	Low	Low
Low	> 1	Low	Low	Low	Low

Receptors that are considered to have a high sensitivity (e.g. residential receptors, schools) are located in excess of 100 m of the site. Therefore, the sensitivity of the area to dust soiling would be assessed as 'low'.

Human Health Impacts

The sensitivity of the area to human health impacts is assessed on the distance of receptors from the various activities and the existing background PM₁₀ concentration. Background PM₁₀ for the local area has been obtained from local monitoring data which indicate that background concentrations for the area are around 14.0 µg m⁻³. Therefore, the sensitivity of the area to human health impacts is determined based on the IAQM guidance as presented in Table 4.3 for background PM₁₀ concentrations of less than 24 µg m⁻³. Receptors are identified as being of High, Medium or Low sensitivity as follows:

- High – locations where members of the public are exposed over a time period relevant to the air quality objective (e.g. exposed for 8 hours or more per day). Indicative examples include residential properties, hospitals, schools and residential care homes.
- Medium – locations where people exposed are workers and are exposed for 8 hours or more per day. Receptors would include office and shop workers but not workers occupationally exposed to PM₁₀.
- Low – locations where human exposure is transient and would include public footpaths, playing fields, parks and shopping streets.

Table 4.3 Methodology for Assessing the Sensitivity of the Area to Human Health Impacts

Phase/ Receptor Sensitivity	No. of Receptors	Distance from Source			
		< 20 m	<50 m	< 100 m	<350 m
High PM ₁₀ < 24 µg m ⁻³	> 100	Medium	Low	Low	Low
	10 - 100	Low	Low	Low	Low
	1 - 10	Low	Low	Low	Low

Medium	1 - 10	Low	Low	Low	Low
PM ₁₀ < 24 µg m ⁻³	> 1	Low	Low	Low	Low
Low	> 1	Low	Low	Low	Low

Based on the surrounding land use, the sensitivity of the area to human health impacts would be assessed as 'low'.

Define the Risk of Impacts

The dust emission magnitude and sensitivity of the area are combined to determine the risk of impacts using Table 7 (earthworks), Table 8 (construction) and Table 9 (trackout) of the IAQM guidance. A summary of the risks is presented in Table 4.4. These are defined on the basis of no mitigation beyond that required by legislation. Where the risk is assessed as 'negligible' no additional mitigation is considered necessary.

Table 4.4 Summary of Dust Soiling Risk and Human Health Risk to Define Site-Specific Mitigation			
Impact	Earthworks	Construction	Trackout
Dust soiling	Negligible	Negligible	Negligible
Human health	Negligible	Negligible	Negligible

For dust soiling and human health, the risk is identified as negligible for earthworks, construction and trackout and no further mitigation would be required. Therefore, it is concluded that the use of good housekeeping practices during construction will be sufficient to minimise construction dust impacts.

4.5 Mitigation

The impact of the site on construction activities has been assessed as negligible. Therefore, it is concluded that the use of good housekeeping practices during construction will be sufficient to minimise construction dust impacts.

5. Predicted Operational Impact on Human Health

5.1 Introduction

The predicted impact of emissions to air from the STOR facility is presented. For each averaging period (e.g. annual mean, maximum hourly mean etc.), the result presented is the maximum for the five years of meteorological data used for dispersion modelling purposes.

A number of assumptions have been made to characterise the various emission sources and the surrounding environment into which these emissions are emitted. Worst-case assumptions have been adopted to avoid underestimating the predicted impact of emissions on air quality. In particular, for short-term impacts it is assumed that the STOR facility operates continuously and results are presented for the worst-case meteorological year.

5.2 Predicted Impact on Human Health

Nitrogen Dioxide

Predicted annual and hourly mean ground level concentrations of NO₂ arising as a result of emissions from the STOR facility are presented in Table 5.1 and Table 5.2, respectively. The significance of the impacts is assessed with regard to the significance criteria for planning. The results are presented for the process contribution (PC) and the predicted environmental concentration (PEC) which is the PC plus the background concentration.

Guidance issued by the Environment Agency's Air Quality Assessment and Modelling Unit (AQMAU)¹² indicates that an initial screening approach would be to assume that 100% of annual average and 50% of peak hourly average concentrations of NO_x are in the form of NO₂. For a more detailed worst case assessment such as this, the guidance recommends a conversion rate of 70% and 35% for annual and hourly concentrations respectively.

For the residential receptors where there is relevant public exposure, the impact would be assessed as 'negligible' except for the Lea Close receptors which are assessed as 'slight adverse'. Highest concentrations are predicted to occur at Lea Close 1 to the north (D4) where the maximum predicted concentration is 3.1 µg m⁻³ (8% of the AQO). However, combined with background concentrations, the PEC is well below the AQO of 40 µg m⁻³. Therefore, taking into consideration the worst-case assumptions adopted for the assessment, the impact of the STOR facility on annual mean NO₂ is assessed as 'not significant'.

¹² Conversion Ratios for NO_x and NO₂, Air Quality Modelling and Assessment Unit of the Environment Agency (undated)

Table 5.1 Predicted Annual Mean Ground Level Concentrations of NO₂ at Sensitive Receptors Arising from the STOR Facility Emissions

Ref	Receptor	Annual Mean PC (µg m ⁻³) (a)	Annual Mean PC as %age of AQS	Annual Mean PEC as %age of AQS (b)	Impact Descriptor (c)
D1	Holybrook Farm	1.0	2%	43%	Negligible
D2	Kennet House	0.3	1%	41%	Negligible
D3	Southcote Mill	0.1	0%	41%	Negligible
D4	Lea Close 1	3.1	8%	48%	Slight adverse
D5	Lea Close 2	2.3	6%	46%	Slight adverse
D6	Lea Close 3	2.3	6%	46%	Slight adverse
D7	Range Wood Avenue	1.6	4%	44%	Negligible
D8	Kennet Valley Primary School	0.5	1%	42%	Negligible
D9	Brunel Road	2.0	5%	45%	Negligible
D10	Allotment Gardens	1.2	3%	43%	NRPE
D11	Dewe Lane	0.1	0%	40%	Negligible
D12	AQMA northeast	0.1	0%	41%	Negligible
D13	AQMA north	0.4	1%	70%	Negligible
(a) As a worst-case, assumes 70% conversion of NO to NO ₂					
(b) Assuming a background concentration of 16.1 µg m ⁻³ for non-roadside receptors and 27.7 µg m ⁻³ for roadside receptors					
(c) No relevant public exposure (NRPE) to annual mean concentrations					

For the short-term objective (99.8th percentile of hourly means), the maximum predicted impact of the STOR facility is 40% of the AQO (D5 Lea Close) and would be described as a 'moderate adverse' impact. In addition, the impact at six other receptors in close proximity to the site would be assessed as 'moderate adverse'.

At all receptors the PEC (background plus process contribution) is well below the AQO and it is unlikely that this would be exceeded.

Table 5.2 Predicted 99.8th Percentile of Hourly Mean Concentrations of NO₂ at Sensitive Receptors Arising from the STOR Facility Emissions

Ref	Receptor	Hourly PC (µg m ⁻³) (a)	Hourly PC as %age of AQS	PEC as %age of AQS (b)	Impact Descriptor
D1	Holybrook Farm	75.1	38%	54%	Moderate adverse
D2	Kennet House	24.7	12%	28%	Slight adverse
D3	Southcote Mill	10.8	5%	22%	Negligible
D4	Lea Close 1	76.9	38%	55%	Moderate adverse
D5	Lea Close 2	80.8	40%	57%	Moderate adverse
D6	Lea Close 3	73.4	37%	53%	Moderate adverse
D7	Range Wood Avenue	61.1	31%	47%	Moderate adverse
D8	Kennet Valley Primary School	21.6	11%	27%	Slight adverse
D9	Brunel Road	55.5	28%	44%	Moderate adverse
D10	Allotment Gardens	49.2	25%	41%	Moderate adverse
D11	Dewe Lane	8.8	4%	21%	Negligible
D12	AQMA northeast	8.2	4%	20%	Negligible
D13	AQMA north	15.9	8%	36%	Negligible

(a) As a worst-case, assumes 35% conversion of NO to NO₂

(b) Assuming a background concentration of 32.2 µg m⁻³ for non-roadside and 55.4 µg m⁻³ for roadside receptors

Therefore, the results show that the short-term process contribution for NO₂ is high relative to the short term NO₂ air quality objective at some sensitive receptors. However, the STOR facility is highly unlikely to operate for the extended period modelled and these predicted concentrations are representative of extreme worst-case conditions. It should be noted that combined with the background concentration, the predicted environmental concentration (PEC) is well below the AQO of 200 µg m⁻³ at all locations. Therefore, it is concluded that the impact on air quality of the STOR facility emissions would be 'not significant' with respect to short-term concentrations of NO₂.

Predicted annual mean and predicted hourly mean (as the 99.8th percentile) ground level concentrations are also presented as contour plots in Figure 5.1 and Figure 5.2, respectively.

For both averaging periods, maximum predicted concentrations occur close to the STOR site and decrease with distance from the site.

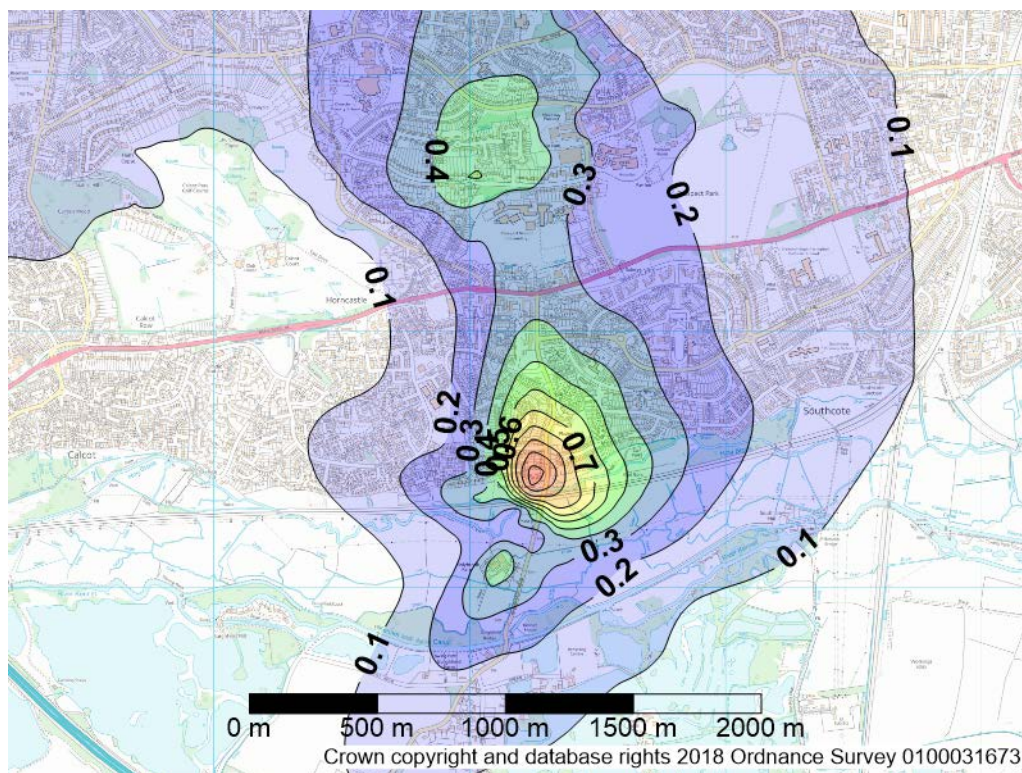


Figure 5.1: Predicted Annual Mean NO₂ Concentrations ($\mu\text{g m}^{-3}$)

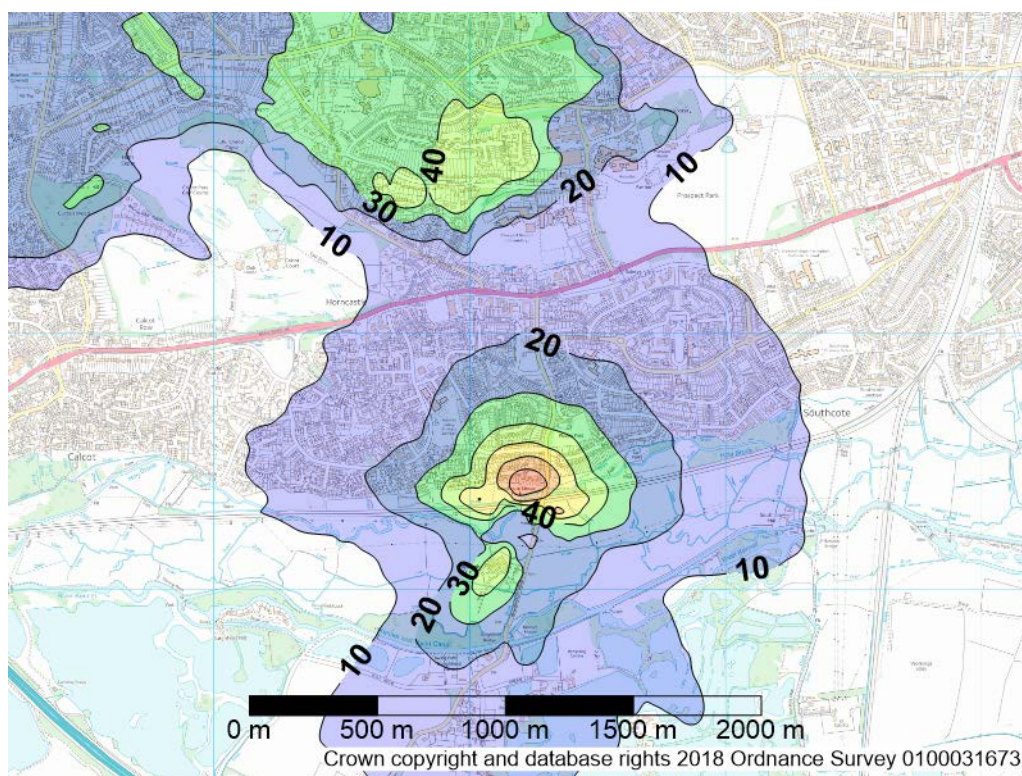


Figure 5.2: Predicted 98th Percentile of Hourly NO₂ Concentrations ($\mu\text{g m}^{-3}$)

Carbon Monoxide

Predicted 8-hourly mean ground level concentrations of CO arising as a result of emissions from the STOR facility are presented in Table 5.3. The significance of the impact is assessed using the planning criteria provided by the IAQM. The results are presented for the process contribution (PC) and the predicted environmental concentration (PEC) which is the PC plus the background concentration.

Table 5.3 Predicted Maximum 8-Hourly Mean Concentrations of CO at Sensitive Receptors Arising from the STOR Facility Emissions

Ref	Receptor	8-Hourly PC ($\mu\text{g m}^{-3}$)	8-Hourly PC as %age of AQS	PEC as %age of AQS (a)	Impact Descriptor
D1	Holybrook Farm	646	6%	9%	Negligible
D2	Kennet House	190	2%	4%	Negligible
D3	Southcote Mill	71.6	1%	3%	Negligible
D4	Lea Close 1	698	7%	10%	Negligible
D5	Lea Close 2	600	6%	9%	Negligible
D6	Lea Close 3	627	6%	9%	Negligible
D7	Range Wood Avenue	475	5%	7%	Negligible
D8	Kennet Valley Primary School	144	1%	4%	Negligible
D9	Brunel Road	456	5%	7%	Negligible
D10	Allotment Gardens	383	4%	6%	Negligible
D11	Dewe Lane	79.5	1%	3%	Negligible
D12	AQMA northeast	59.9	1%	3%	Negligible
D13	AQMA north	97.1	1%	6%	Negligible

(a) Assuming a background concentration of $255 \mu\text{g m}^{-3}$ for non-roadside and $510 \mu\text{g m}^{-3}$ for roadside receptors

The maximum predicted at sensitive receptors ($698 \mu\text{g m}^{-3}$) is 7% of the AQO of $10,000 \mu\text{g m}^{-3}$ and would be assessed as a 'negligible' impact in accordance with the IAQM planning guidance. For the other sensitive receptors, the impacts are also assessed as 'negligible'. Therefore, it is concluded that the impact of the STOR facility on short-term concentrations of CO is 'not significant'.

6. Predicted Operational Impact on Habitat Sites

6.1 Critical Levels and Critical Loads

Introduction

There are many impacts on ecosystems associated with elevated levels of atmospheric nitrogen and its deposition to sensitive habitats. The most important of these are ¹³ :

- short term direct effects of nitrogen gases and aerosols on individual species;
- soil mediated effects;
- increased susceptibility to secondary stress factors, such as drought or frost; and
- changes in (competitive) relationships between species, resulting in loss of biodiversity.

In order to provide benchmark levels, below which significant harmful effects to the environment do not occur, critical levels and critical loads have been developed referring to gaseous airborne concentrations of pollutants and deposition of pollution to land and water, respectively.

Critical Levels

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals. High concentrations of pollutants in ambient air directly cause harm to leaves and needles of forests and other plant communities. Critical levels for NO_x are provided in Section 2.2.4.

Critical Loads

Introduction

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. This takes the form of either gravitational settling of particulate matter (dry deposition) or wet deposition, where atmospheric pollutants dissolve in water vapour and then precipitate to the ground (e.g. as rain, snow, fog etc.).

The issue for ecosystems is the risk that the deposition rate of acid (acidification) or nutrient nitrogen (eutrophication) may be in excess of the amount that the ecosystem can tolerate. The point at which this occurs is the 'critical load'.

Eutrophication

Critical loads for nutrient nitrogen are determined largely on the basis of the species or habitat type affected. Critical loads have been determined for a number of habitat types at the European level and

¹³ Air Quality Guidelines for Europe, Second Edition, WHO Regional publications European Series No. 91, Chapter 11: Effects of nitrogen-containing air pollutants: critical levels, Chapter 14 : Effects of airborne nitrogen pollutants on vegetation: critical loads (2000)

reflect the way different plants have adapted to differing availabilities of nutrient. Those in nutrient deficient environments, e.g. coastal sand dunes, will be less tolerant of excess nitrogen from aerial deposition.

Critical loads for eutrophication at the identified sensitive European habitat site, obtained from the Air Pollution Information System (APIS)¹⁴ are summarised in Table 6.1.

Table 6.1 Critical Loads for Eutrophication		
Habitat Site	Most Sensitive Habitat Type	Critical Load (kg N ha ⁻¹ a ⁻¹)
H1. Hartslock Wood SAC	Coniferous woodland	5 – 15

Acidification

For acidification, the critical load of a habitat site is determined mostly by the underlying geology and soils. Alkaline soils have an innate capacity for neutralising acidic deposition, whereas acidic soils do not. The level of acidification depends on the donation of hydrogen ions to the soil arising primarily from deposition of:

- sulphur dioxide, which reacts with water to produce sulphuric acid;
- nitrogen oxides, which react with water to produce nitric acid; and
- acid gases such as hydrogen chloride.

The critical load of acidification is defined by a critical load function which describes the relationship between the relative contributions of sulphur (S) and nitrogen (N) to the total acidification.

The critical load function is defined by the following parameters:

- CL_{maxS}, the maximum critical load of acidity for S, assuming there is no N deposition;
- CL_{minN}, is the critical load of acidity due to nitrogen removal processes in the soil only (i.e. independent of deposition); and
- CL_{maxN}, is the maximum critical load of acidity for N, assuming there is no S deposition.

There are no significant emissions of sulphur from the STOR facility. Therefore, the critical level for nitrogen only is considered. The values of this parameter (as provided by APIS) for the selected European habitat site are presented in Table 6.2.

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Table 6.2 Critical Loads for Acidification ($\text{keq ha}^{-1}\text{a}^{-1}$)

Habitat Site	Most Sensitive Habitat Type	C _{max} N
H1. Hartslock Wood SAC	Unmanaged broadleaved/ coniferous woodland	1.95

6.2 Background Concentrations and Deposition Fluxes

Introduction

Information on background nutrient nitrogen deposition, acidification and airborne concentrations of NO_x is provided by the Centre for Ecology and Hydrology (CEH) and available from the Air Pollution Information System (APIS) website.

Airborne Concentrations

Background NO_x concentrations for the area surrounding the site have been obtained from the APIS and are summarised in Table 6.3.

Table 6.3 Airborne Concentrations of NO_x at Sensitive Habitat Site

Habitat Site	Annual Mean NO _x ($\mu\text{g m}^{-3}$)	24-hour Mean NO _x ($\mu\text{g m}^{-3}$) (a)
H1. Hartslock Wood SAC	22.6	26.7
H2. Lousehill Copse LNR	23.2	27.4
H3. Churchend Copse AW	21.1	24.9
H4. Curtis's Wood AW	20.1	23.7
H5. Walker's Shaw AW	26.9	31.7
H6. Dean's Copse AW	25.0	29.5
<i>Critical level</i>	<i>30</i>	<i>75</i>

(a) Derived from the annual by multiplying by 2 to generate an hourly mean and 0.59 to convert to a 24-hour mean

Background concentrations of NO_x at the habitat site are below the annual mean and the 24-hour mean critical levels of $30 \mu\text{g m}^{-3}$ and $75 \mu\text{g m}^{-3}$, respectively.

Nutrient Nitrogen Deposition (Eutrophication) and Acidification

APIS is able to provide an indication of background nutrient nitrogen deposition and acidification by geographical location and habitat type. The estimates are made from 5 km resolution mapped data, which are derived from a combination of modelling studies and measured deposition and acidification

rates¹⁵. There is an inherent level of uncertainty resulting from this process, particularly in areas with significant emissions sources. However, in the absence of local measurements, the APIS data provides a useful benchmark for comparison with deposition and acidification rates predicted by the dispersion model. A summary of the background fluxes provided by APIS for habitat sites selected for the assessment is presented in Table 6.4.

Table 6.4 Background Nitrogen Deposition and Acidification Fluxes		
Habitat Site	Background Nutrient Nitrogen Flux (kg N ha ⁻¹ a ⁻¹)	Background Acidification Flux N (keq ha ⁻¹ a ⁻¹)
H1. Hartslock Wood SAC	25.48	1.82

For the Hartslock Wood SAC, the background deposition rate for nutrient nitrogen exceeds the lower critical load for the habitat by a factor of more than five.

6.3 Predicted Impact of Emissions on Habitat Sites

Airborne Concentrations of NO_x

Predicted concentrations of NO_x at the habitat sites are presented in Table 6.5 and compared to the relevant critical levels.

Table 6.5 Predicted Airborne NO _x Concentrations at Habitat Sites				
Habitat	Annual Mean PC NO _x (µg m ⁻³)	Annual Mean PC as %age of Critical Level	24 Hour Mean PC NO _x (µg m ⁻³)	24 Hour Mean PC as %age of Critical Level
H1. Hartslock Wood SAC	0.03	0.1%	0.4	0.5%
H2. Lousehill Copse LNR	0.43	1.4%	3.5	4.6%
H3. Churchend Copse AW	0.24	0.8%	1.7	2.3%
H4. Curtis's Wood AW	0.12	0.4%	1.4	1.9%
H5. Walker's Shaw AW	0.08	0.3%	1.4	1.9%
H6. Dean's Copse AW	0.12	0.4%	1.6	2.1%

For NO_x, the predicted annual mean concentration at the habitat sites are low given the distance of these habitat sites from the proposed STOR facility location. The predicted concentrations are less than 1% of the critical level for the European site and less than 100% of the critical level for the local wildlife sites. Therefore, it is concluded that the likely impact of emissions on these habitats would be 'not significant'.

15 Transboundary Air Pollution: Acidification, Eutrophication, and Ground Level Ozone in the UK, NEGTA, EPG 1/3/153, 2001

For the 24-hour mean, the predicted impacts at the habitats are also assessed as 'not significant' as the PC's are less than 10% of the critical level for the European site and less than 100% of the critical level for the Ancient Woodland and LNR.

Nutrient Nitrogen Deposition

Deposition of nitrogen compounds causes eutrophication and has been taken into account in assessing the impacts of the STOR facility on the European site. A summary of the predicted PC and PEC is provided in Table 6.6 along with the predicted exceedence and deposition as a proportion of the critical load.

Table 6.6 Maximum Predicted PCs and PECs for Nutrient Nitrogen Deposition				
Habitat	PC N (kgN ha ⁻¹ a ⁻¹)	PC %age of Critical Load	PEC N (kgN ha ⁻¹ a ⁻¹)	PEC %age of Critical Load
H1. Hartslock Wood SAC	0.01	0.2%	25.49	510%

For the habitat, the PC represents less than 1% of the relevant site-specific critical load and it is concluded that the STOR facility would not have a significant impact on the European site. The PEC exceeds the relevant critical load due to elevated background nutrient nitrogen deposition.

Acidification

Deposition of nitrogen compounds causes acidification and has been taken into account in assessing the acidification impacts of the STOR facility on the European site which is sensitive to acidification impacts. The predicted acidification rate for the habitat sites is presented in Table 6.7.

Table 6.7 Maximum Predicted Acidification Deposition at Habitat Sites				
Habitat	PC N (kgN ha ⁻¹ a ⁻¹)	PC %age of Critical Load	PEC (keq ha ⁻¹ a ⁻¹)	PEC %age of Critical Load
H1. Hartslock Wood SAC	0.001	<0.1%	1.82	93%

At the habitat site, the PC represents less than 1% of the relevant critical load. Therefore, it is concluded that the impact of the STOR facility emissions on these habitats would be not significant.

Predicted Impact of Emissions on Local Wildlife Sites

The impact of emissions on local wildlife sites (LWS) has not been assessed specifically. In accordance with Environment Agency guidance, impacts are assessed as significant where the predicted impact is greater than 100% of the critical level or critical load. Contour plots of annual mean and 24-hour mean NO_x are presented in Figures 6.1 and 6.2, respectively. These demonstrate that predicted concentrations do not exceed the annual mean critical level of 30 µg m⁻³ or the 24-hour mean critical level of 75 µg m⁻³ at any location within the model domain.

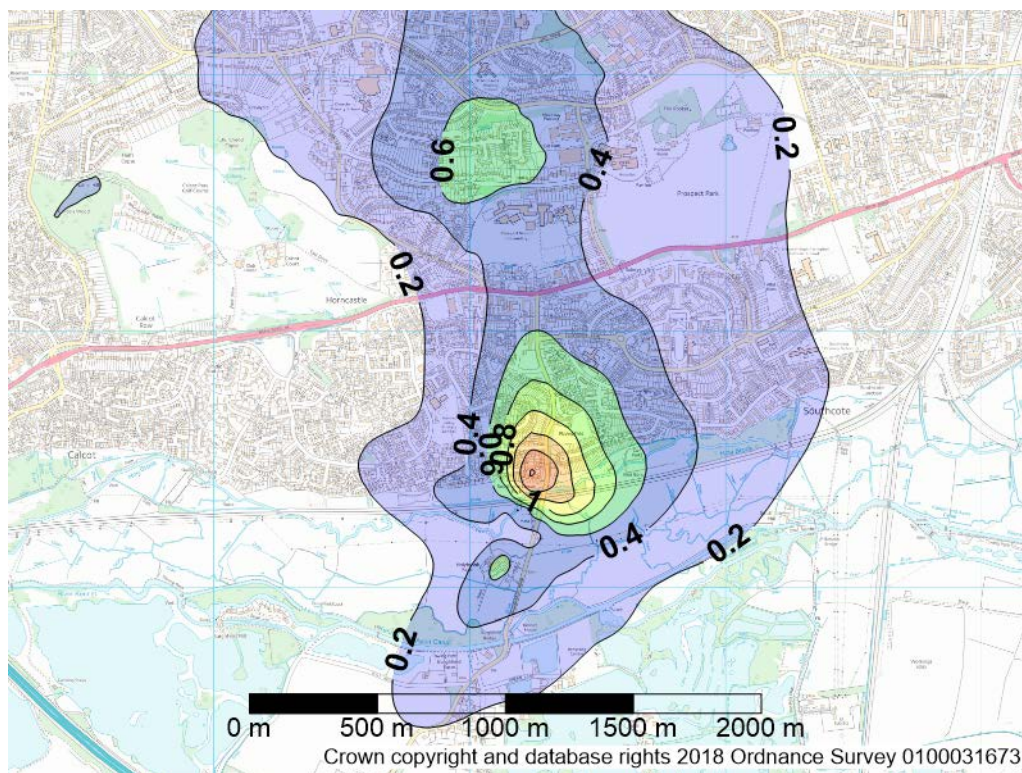


Figure 6.1: Predicted Annual Mean NO_x Concentrations ($\mu\text{g m}^{-3}$)

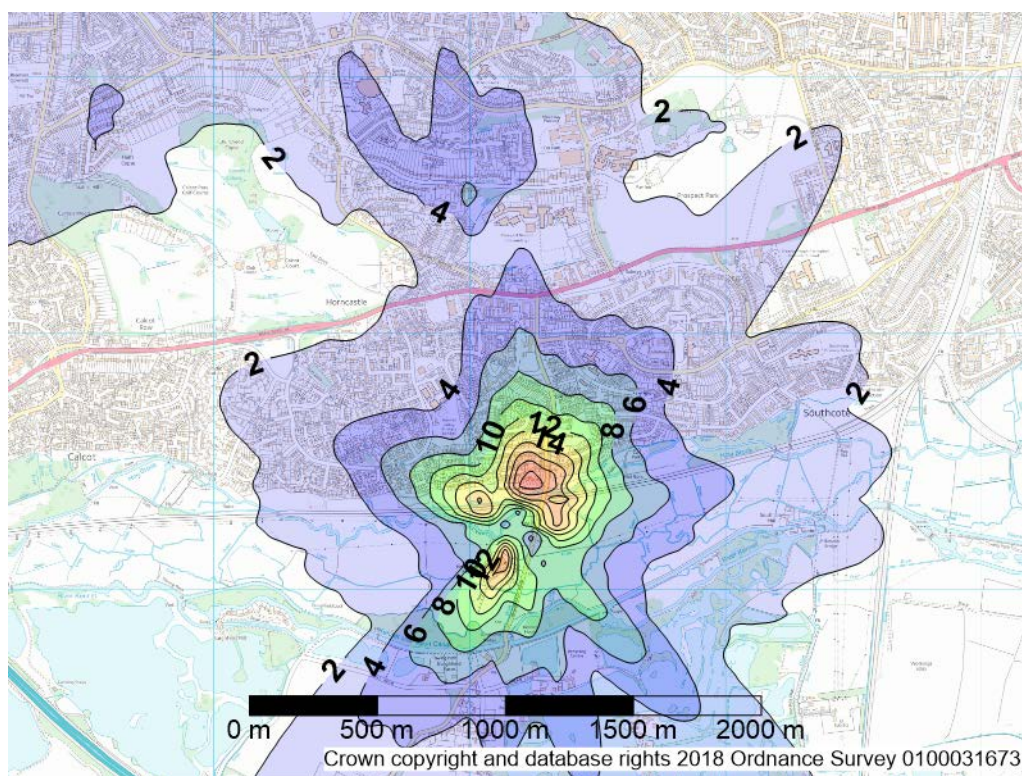


Figure 6.2: Predicted Maximum 24-Hour NO_x Concentrations ($\mu\text{g m}^{-3}$)

7. Summary and Conclusions

7.1 Summary

An air quality assessment for the proposed STOR facility has been carried out to support the planning application for the proposed site activities. The assessment has considered both construction and operational impacts. The STOR facility is designed to generate a total of 20 MWe and would operate for up to 2,000 hours per year.

The impact of construction activities has been carried out in accordance with guidance provided by the Institute of Air Quality Management (IAQM).

The assessment of operational impacts has focussed on emissions from the STOR facility and emissions of the oxides of nitrogen (NO_x) and carbon monoxide (CO). The impact of emissions on human health and habitats has been assessed. The air quality assessment has been carried out in accordance with guidance produced by the Institute of Air Quality Management (IAQM) for planning.

Where there is relevant long-term public exposure (e.g. residential properties), the predicted long-term impact of nitrogen dioxide (NO₂) emissions on sensitive receptors would be described as ‘negligible’ in accordance with the IAQM criteria except at one location which would be assessed as ‘slight adverse’.

For predicted short-term concentrations of NO₂ the impact would be described as having a ‘moderate adverse’ impact at some receptors. However, this assumes as a worst-case that the facility operates continuously when in reality it would operate for less than 25% of the time. Furthermore, predicted environmental concentrations (STOR facility contribution plus background) are well below the air quality objective.

Predicted maximum 8-hour concentrations of CO arising from the STOR facility are less than 10% of the air quality objective at sensitive receptors and in accordance with the IAQM planning guidance would be assessed as ‘negligible’.

The assessment has also considered the impact of the STOR facility on sensitive habitat sites. There is one European site within 10 km and one LNR and four Ancient Woodlands within 2 km of the site. Therefore, the assessment has considered airborne concentrations of NO_x on Ancient Woodlands and Local Nature Reserves and nutrient nitrogen deposition and acidification on the European site.

For NO_x, predicted annual mean and 24-hour mean NO_x concentrations at the European site were less than 1% and 10% of the critical levels, respectively. At local wildlife sites predicted concentrations were less than 100% of the critical levels. Therefore, airborne emissions of NO_x generated by the facility would be assessed as ‘not significant’ for all habitat sites.

For acidification and nutrient nitrogen deposition at the European site, the contribution of the STOR facility is less than 1% of the relevant critical loads and these impacts would be assessed as 'not significant'.

7.2 Conclusions

Therefore, based on the quantitative assessment carried out, it is concluded that the impact of the STOR facility on human health and sensitive habitat sites would be not significant. Therefore, it is considered that there are no constraints to the development as proposed.