TIDAL LAGOON SWANSEA BAY

Environmental Statement
Chapter 16. Air Quality

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Contents

16.0 Air quality

16.1 Introduction

16.1.0.1 This Chapter provides an assessment of the potential impacts to air quality resulting from the Project. The Chapter describes the methodology used to define baseline conditions for the Project and surrounding area, assesses the significance of potential effects and describes any mitigation measures required to prevent, reduce or offset any significant adverse effects identified during the assessment. It also presents the likely impact of the Project cumulatively with other schemes in the surrounding area.

16.1.0.2 This Chapter provides an assessment of the impacts associated with emissions generated by road traffic attributed to the construction, operational and decommissioning phases of the Project, as well as the potential for dust generation during construction works. The effect on Aeolian sand processes is discussed in the terrestrial ecology chapter of this ES (Chapter 12). Traffic associated with major sporting events that might be hosted at the Project during the operational phase has also been considered.

16.2 Legislation, planning policy and guidance

16.2.1 European Directive

16.2.1.1 The Ambient Air Quality and Cleaner Air for Europe Directive 2008/50/EC is currently transposed into UK legislation by the Air Quality Standards Regulations 2010. These EU limit values are binding on the UK and have been set with the aim of avoiding, preventing or reducing harmful effects on human health and on the environment as a whole resulting from poor air quality.

16.2.2 National Air Quality Strategy

16.2.2.1 The UK National Air Quality Strategy was published initially in 2000, under the requirements of the Environment Act 1995. The most recent revision of the strategy sets objective values for key pollutants as a tool to help local authorities to manage local air quality improvements in accordance with the EU Air Quality Framework Directive, EU 96/62/EC. Some of these objective values have subsequently been laid out within the Air Quality (Wales) Regulations 2000 as amended.

16.2.2.2 The air quality objective values referred to above have been set down in regulations solely for the purposes of local air quality management. Under the Local Air Quality Management (LAQM) regime, local authorities have a duty to carry out regular assessments of air quality against the objective values and if it is unlikely that the objective values will be met in the given timescale, they must designate an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) with the aim of achieving the objective values. The boundary of an AQMA is set by the governing local authority to define the geographical area that is subject to the management measures to be set out in a subsequent action plan. Consequently it is not unusual for the boundary of an AQMA to include within it some locations where air quality is not at risk of exceeding an air quality objective.

16.2.2.3 The national air quality objective values for the pollutants of relevance to this assessment are presented in Table 16.1.

Table 16.1 National air quality strategy objectives

Pollutant	Objective ($\mu g/m^3$)	Averaging Period	Percentile	To be met by/In force from
HUMAN HEALTH OBJECTIVES				
Nitrogen dioxide (NO_2)	200	1 hour	Objective not to be exceeded more than 18 times per year, equivalent to 99.8th percentile	31 Dec 2005
	40	Annual	Mean	31 Dec 2005
Particulate matter (PM_{10})	40	Annual	Mean	31 Dec 2004
	50	24 hour	Objective not to be exceeded more than 35 times per year, equivalent to 90.4th percentile	31 Dec 2004
Particulate matter ($PM_{2.5}$)	25	Annual	Mean	1 Jan 2020
VEGETATION AND ECOSYSTEM OBJECTIVES				
Oxides of Nitrogen (NO_X)	30	Annual	Mean	31 Dec 2000

16.2.3 Planning Policy Wales

16.2.3.1 Planning Policy Wales (PPW) is the principal source of national planning policy in Wales. PPW sets out the land use planning policies of the Welsh Government and is supplemented by topic based Technical Advice Notes ("TAN"). It recognises that air quality can be a material consideration in deciding whether to grant planning permission, and as such is capable of being an important and relevant matter.

16.2.3.2 Additional planning policies relevant to air quality management include Policy Guidance Note for Wales 'LAQM.PG09(W)' which represents all aspects of policy, including air quality reviews and assessments, air quality action planning, transport planning, and land use planning.

16.2.3.3 There is no TAN specifically related to air quality, though TAN 18 'Transport' recognises that clean air is an essential ingredient of a good quality of life and that transport emissions contribute significantly to climate change and poor local air quality.

16.2.4 Local Planning Policy

16.2.4.1 The onshore infrastructure of the Project will be located in the administrative areas of both the City and County of Swansea Council (CCSC) and Neath Port Talbot County Borough Council (NPTCBC). Furthermore, it is proposed that the offshore elements of the Project will be incorporated in the administrative area of CCSC. As a result, both Councils’ planning policies have been considered in this assessment.

16.2.4.2 The CCSC Unitary Development Plan was adopted in 2008 and it is the most up to date Development Plan covering the administrative area of either authority. Policy EV40 of the CCSC Unitary Development Plan highlights that development proposals will not be permitted that would cause or result in significant harm to health, local amenity, natural heritage or the environment because of significant levels of air pollution.

16.2.4.3 CCSC has a designated AQMA in the Lower Swansea Valley, the Swansea AQMA 2010. The AQMA includes three areas, namely Sketty, Fforestfach and Hafod due to elevated annual mean concentrations of nitrogen dioxide (NO_2) (CCSC, 2013).

16.2.4.4 The NPTCBC Unitary Development Plan was adopted in 2008 as the development plan for the whole of the Neath Port Talbot area and recognises that air quality can be a material planning consideration.

16.2.4.5 NPTCBC has designated an AQMA in the Margam, Taibach and Port Talbot neighbourhood in 2000, covering the majority of land and properties between the Tata Steel Works and the M4 Motorway for exceedances of the 24 hour particulate matter (PM_{10}) objective. (NPTCBC, 2013).

16.3 Assessment methodology

16.3.1 Overview

16.3.1.1 This section presents the methodology adopted for assessing the significance of the likely air quality effects associated with the construction, operation and decommissioning of the Project.

16.3.1.2 The approach used initially establishes the baseline conditions. The magnitude of the change (impact) is then determined at receptor locations that are representative of the locations surrounding them, for scenarios based on the construction, operational and decommissioning phases of the Project. The effect at these individual receptors is described and then the significance of the overall effect is assessed for the study area as a whole, using an approach that is consistent with current 2009 guidance from the Institute of Air Quality Management (IAQM).

16.3.1.3 In order to quantify the baseline air pollutant concentrations for the Project, and the magnitude of the predicted impact attributed to additional road traffic flows associated with the Project, an air quality study has been undertaken using the most recent 2013 version of the Atmospheric Dispersion Modelling System for road modelling (ADMS-Roads). This computer package has been developed specifically by Cambridge Environmental Research Consultants Ltd (CERC) for road traffic emissions studies in the UK and is a modern dispersion model that has an extensive published track record of use in the UK for the assessment of local air quality impacts, including model validation and verification studies. The model outputs have subsequently been adjusted using the 'NOx to NO_2' conversion tool that supports the LAQM Technical Guidance Note TG(09).

16.3.1.4 This dispersion model utilises traffic volume data, average speed and emission factors, along with meteorological conditions, in order to predict ground level concentrations of specified emissions at specified receptor points.

16.3.1.5 The potential impacts of dust emissions from construction phase works for the Project are considered using a qualitative method that takes into account the potential sources of emissions, the nature of those emissions, the location and sensitivity of receptors and the mitigation measures incorporated into the Project.

16.3.1.6 As a Part B process, the concrete batching plant that will be required during the construction phase will require an environmental permit, as set out in DEFRA's Environmental Permitting document, 'General Guidance Manual on Policy and Procedures for A2 and B Installations' for Local authority Integrated Pollution Prevention and Control (LA-IPPC) and Local Authority Pollution Prevention and Control (LAPPC) (DEFRA, 2012a). It is the role of the Pollution Control Authority to ensure that mitigation measures applied to control emissions from the batching plant represent best available techniques (BAT) and would be effective in preventing significant effects at any relevant receptor locations. The effectiveness of the proposed mitigation would be considered by the Pollution Control Authority as part of the Environmental Permit application process. For this reason, the significance of emissions from batching plant can reasonably be considered to not be significant and therefore have not been considered further in this assessment.

16.3.1.7 The BAT approach balances the costs to the operator against the benefits to the environment. More information can be found in Chapter 12 and Annex VIII of 'General Guidance Manual on Policy and Procedures for A2 and B Installations' (DEFRA, 2012a). Experience in the UK (DEFRA, 2012a) is that BAT and good site practice at concrete batching plants are capable of controlling the impact of fugitive emissions of particulate matter effectively so that impacts at receptors can be controlled to ensure that effects are not significant.

16.3.1.8 Figure 16.1, Volume 2, illustrates the Project area and nearest sensitive receptors, which are discussed in more detail below.

16.3.1.9 This ES proceeds on the basis of the outline construction programme as discussed in Chapter 4, Section 4.5.2, which anticipates construction starting in 2015 and with the main construction lasting for about three years. The assessments contained in this chapter are not materially sensitive to works commencing within the anticipated validity of the DCO, which is five years, or to an extension of (say) a further year-or-so.

16.3.2 Desk study and consultation

16.3.2.1 The following documents were reviewed to ascertain baseline air pollution in the vicinity of the Project site:

i. CCSC '2012 Air Quality Updating and Screening Assessment for the City & County of Swansea';

ii. CCSC 'Draft 2013 Air Quality Progress Report for the City & County of Swansea';

iii. NPTCBC '2009 Air Quality Updating and Screening Assessment for Neath Port Talbot County Borough Council'; and

iv. NPTCBC 'Draft 2013 Air Quality Progress Report for Neath Port Talbot County Borough Council'.

16.3.2.2 The methodology employed in this assessment uses guidelines and data set out in the following documents:

I. 'Local Air Quality Management Guidance for Wales', LAQM.PG W (09); Welsh Government

II. 'Local Air Quality Management Guidance, LAQM.TG (09)''; Defra

III. 'Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance', IAQM;

IV. 'Position on the Description of Air Quality Impacts and the Assessment of their Significance', IAQM;

V. Air Pollution Information System (APIS)[1]; and

VI. 'Design Manual for Roads and Bridges' (DMRB), Volume 11, Section 3, Part 1, HA 207/07, Highways Agency

16.3.2.3 Martin Hooper (Pollution Control Officer) of NPTCBC and Phil Govier (Environmental Management Systems Development Officer) of CCSC were contacted to discuss baseline air quality measurement data and the need for additional monitoring. CCSC confirmed there was no need for additional sampling of air quality (email 04/07/2013).

16.3.2.4 Environmental Health Officers at CCSC and NPTCBC were contacted directly regarding the assessment of odour, as detailed in section 16.4.2 of this report.

16.3.2.5 The methodology for the air quality assessment was presented in the Preliminary Environmental Information Report (PEIR) which was submitted for consultation in June 2013. Comments received from this consultation, have been considered and the approach leading to this ES has been adapted as part of the EIA process.

16.3.3 Study pollutants

16.3.3.1 Vehicle exhaust emissions (e.g. from petrol and diesel combustion) comprise a complex mixture of organic and inorganic substances. Of these emissions, assessment criteria exist for a number of pollutants listed.

16.3.3.2 Table 16.1 (above) presents the relevant assessment criteria for the study pollutants based on the limits included in the Air Quality Regulations 2010. Concentrations are expressed as the mass of pollutant (micrograms) per cubic metre of air ($\mu g/m^3$). Table 16.2 presents the national Air Quality Strategy objectives for the 2012 baseline.

Table 16.2 National air quality strategy objective values (in $\mu g/m^3$)

Pollutant	Objective	Averaging Period	Percentile
HUMAN HEALTH OBJECTIVES			
Nitrogen dioxide (NO_2)	200	1 hour	Objective not to be exceeded more than 18 times per year, equivalent to 99.8th percentile
	40	Annual	Mean
Particulate matter (PM_{10})	40	Annual	Mean
	50	24 hour	Objective not to be exceeded more than 35 times per year, equivalent to 90.4th percentile
Particulate matter ($PM_{2.5}$)	25	Annual	Mean
VEGETATION AND ECOSYSTEM OBJECTIVES			
Nitrogen oxides (NO_X)	30	Annual	Mean

[1] http://www.apis.ac.uk

16.3.3.3 There are no statutory limits for dust, which is defined in BS 6069-2 as particulate matter in the size range 1-75 µm in diameter, or (gaseous) pollutant deposition.

16.3.3.4 Critical loads exist for nitrogen deposition at both the nearest protected ecology sites, Crymlyn Burrows Site of Special Scientific Interest (SSSI) and Crymlyn Bog (SSSI, Special Area of Conservation (SAC) and Ramsar site), which are discussed in Section 16.4.7. Further details of these sites and their ecological protection are given in Chapter 12 Terrestrial Ecology. A critical load is *"a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge"*, as defined by the UNECE[2].

16.3.3.5 Those parameters which have not been included in this assessment are discussed in Table 16.3 below, along with the reasons for their omission.

Table 16.3 Parameters not included in the assessment

Pollutant	Reason for omission
Lead	Lead has been removed from petrol fuels and is now deemed to be insignificant.
Sulphur dioxide	The introduction of low sulphur diesel and the relatively insignificant sulphur content of petrol fuels is expected to render SO_2 emissions insignificant.
Carbon monoxide, benzene or 1,3-butadiene	Only Plymouth City Council currently has a designated AQMA due to an exceedance of carbon monoxide, benzene or 1,3-butadiene objectives, and as such these parameters do not apply to the South Wales area.

16.3.3.6 NPTCBC's and CCSC's most recent LAQM Progress Reports in 2013 confirm that NO_2 and PM_{10} are the two pollutants of concern within the boroughs:

i. Particulate Matter, PM_{10} and $PM_{2.5}$ – Fine particles are composed of a wide range of materials arising from a variety of sources, including combustion (mainly road traffic) and the suspension of soils and dusts from construction work, for example. Particles are measured in a number of different size fractions according to their mean aerodynamic diameter. Most monitoring is currently focussed on PM_{10}, which has an aerodynamic diameter of 10 micrometres (µm) or less, but the finer fractions such as $PM_{2.5}$ and PM_1 are becoming of increasing interest in terms of health effects. PM_{10} can be carried deep into the lungs where they can cause inflammation and a worsening of the condition of people with heart and lung disease; and

ii. Nitrogen dioxide (NO_2) and Oxides of nitrogen (NO_X) – NO_X predominately comprises nitric oxide (NO) and NO_2. NO is mainly derived from road transport emissions and other combustion processes, such as the electricity supply industry. Although NO is not considered to be harmful to health, once released to the atmosphere it is usually very rapidly oxidised into NO_2, for which a health based standard has been set.

16.3.4 Model input data - traffic data

16.3.4.1 The air quality assessment used present day Annual Average Daily Traffic flows and these are presented in Appendix 16.1, Volume 3. Traffic speeds used in the ADMS-Roads model were assigned according to the speed limit on each stretch of road. 30 miles per hour (mph) speeds were assumed for side roads. Fabian Way is a dual carriageway for its whole length. The speed limit is 30 mph between Swansea city centre and Port Tennant, after which the speed limit rises to 50 mph until the Jersey Marine roundabout. The road is a standard

[2] http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.html

national speed limit dual carriageway between Jersey Marine and the junction with the M4. For the parts of the road network that were near junctions, average speeds were reduced in the model.

16.3.4.2 Within ADMS-Roads, road vehicle emission factors from the Emission Factors Toolkit (version 5.1) COPERT4v8.1 are used to derive emissions for NO_X, PM_{10} and $PM_{2.5}$ (DEFRA, 2012b). In light of recent debate about whether concentrations of NO_2 are falling as was forecast (Carslaw et al., 2011), and to present a conservative assessment, 2012 emission factors have been used for the baseline and also the future scenarios. Baseline and future year NO_X concentrations have been converted to NO_2 taking account of 2012 factors.

16.3.5 Nearshore plant

16.3.5.1 The nearshore plant associated with the onshore construction works and shore-side Lagoon seawall construction is detailed in Chapter 4: Project Description and further details are presented later in this Chapter. As the works are at a coastal location predominantly within and adjacent to the working Port of Swansea, the need for air quality modelling of construction plant is judged not to be required; it is expected to be similar in scale to the existing activity at the Port and sufficient distance from sensitive receptors not to cause a significant change in ambient air quality concentrations.

16.3.6 Ecological sites

16.3.6.1 Emissions from traffic sources relating to the Project could potentially contribute to nitrogen deposition at nearby ecological receptors. This has been assessed at the nearest ecological habitat sites consistent with the assessment procedure outlined in Highways Agency guidance HA 207/07 (Highways Agency, 2007).

16.3.6.2 The deposition rate for the 5x5 km grid square in which the ecological sites are situated has been obtained from the APIS for 2009-11. The deposition rate is reduced by 2% each year (taking the APIS value as a 2010 value) to estimate the deposition rate for the assessment year.

16.3.6.3 Dry deposition rates are estimated by applying the following formula, based upon a deposition velocity for NO_2 of 1 mm/s: 1 $\mu g/m^3$ of NO_2 = 0.1 kg N /ha/year.

16.3.6.4 It has not been considered necessary to consider sulphur deposition and acidification given the ultra low sulphur content of fuels in the UK.

16.3.7 Modelled domain and receptors

16.3.7.1 There are several existing sensitive receptors in the vicinity of the Project, including student accommodation on the Swansea University Bay Campus (SUBC) which is currently under construction, and residential properties located between Fabian Way, Elba Crescent and Baldwin's Crescent. The Crymlyn Burrows SSSI also lies within close proximity to the Project and has been included as a sensitive receptor for the air quality assessment.

16.3.7.2 Slightly more distant from the Project lies the Crymlyn Bog (or Pant-Y-Sais) SSSI, located approximately 600m to the north of the Project which extends to within 60m of the A483 – Fabian Way.

16.3.7.3 Within the ADMS-Roads model, specified sensitive receptor points (such as residential housing) may be chosen, at which modelled ground level concentrations of each pollutant can be calculated. Along with specific sensitive locations, receptors are also included to represent kerbside locations where changes in pollutant concentrations are likely to be most pronounced.

16.3.7.4 Six air quality receptor locations have been identified, as detailed below (1-6), and were presented in the PEIR (TLSB, 2013) that was submitted for consultation. Following feedback from the PEIR consultation, Receptor 7 was added. Figure 16.1, Volume 2 illustrates the receptor locations.

i. Receptor 1 (269356, 192945): Northwest corner of SUBC, south of A483 - Fabian Way;

ii. Receptor 2 (270423, 193111): North of the Site, 15m north of A483 - Fabian Way. Located at the traffic light junction of Elba Crescent and Fabian Way;

iii. Receptor 3 (270739, 193138): South of A483 - Fabian Way at the northern boundary of Crymlyn Burrows SSSI;

iv. Receptor 4 (271564, 193319):South of Fabian Way/Fford Amazon roundabout at the northern boundary of Crymlyn Burrows SSSI;

v. Receptor 5 (270358, 193654): Crymlyn Bog SAC, Ramsar and SSSI;

vi. Receptor 6 (266880, 193166): Residential properties at Lamberts Road, along Fabian Way; and

vii. Receptor 7 (266533, 193202): Residential properties at the corner of Sebastopol Street and Fabian Way.

16.3.8 Significance criteria - construction dust

16.3.8.1 An assessment of the risk of dust generation to cause annoyance and/or health effects has been undertaken using the criteria outlined in the IAQM's 2012 'Guidance on the Assessment of the Impacts of Construction on Air Quality and Determination of their Significance'.

16.3.8.2 Table 16.4 presents the IAQM significance criteria for dust emissions, assuming best practice mitigation measures are implemented.

Table 16.4 Significance of construction impacts with mitigation in place

Sensitivity of Surrounding Area	Risk of Site Giving Rise to Dust Effects		
	High	Medium	Low
Very High	Minor Adverse	Minor Adverse	Negligible
High	Minor Adverse	Negligible	Negligible
Medium	Negligible	Negligible	Negligible
Low	Negligible	Negligible	Negligible

16.3.9 Significance criteria – traffic emissions

16.3.9.1 The assessment of potential impacts associated with traffic emissions and their significance has been based on the criteria outlined in the 2009 guidance from the IAQM on the assessment of significance. The approach proposed by IAQM has been widely adopted in the UK and forms the basis of subsequent guidance published by Environmental Protection UK (EPUK) in 2010.

16.3.9.2 The significance of an impact is a factor of both the magnitude of the change caused by the Project and the absolute concentrations in relation to the air quality objective. Particular significance is given to a change that takes the concentration from below to above the objective, or vice versa, because of the importance ascribed to the objectives in assessing air quality.

16.3.9.3 Table 16.5 presents criteria for the determination of the 'magnitude of change', based on the percentage increase in concentrations and absolute pollutant concentrations. Table 16.6 presents the impact descriptors associated with this change relative to the objectives.

16.3.9.4 Major or moderate effects on air quality sensitive receptors are considered to represent significant effects. Minor or negligible effects are not considered to be significant.

Table 16.5 Definition of impact magnitude for changes in pollutant concentrations

Magnitude of Change	Annual Mean *	24 hour PM_{10} *
Large	Increase/decrease >10%	> 4 days
Medium	Increase/decrease 5-10%	2 – 4 days
Small	Increase/decrease 1-5%	1 – 2 days
Imperceptible	Increase/decrease <1%	< 1 day

* Annual mean criteria derived from IAQM 2009 guidance; 24 hour PM_{10} criteria from the EPUK 2010 guidance

16.3.9.5 The significance criteria were not designed to assess increases in mean annual NOx concentrations against the objective for protecting sensitive ecosystems - many places in the UK currently exceed the NOx objective and NOx concentrations arising from combustion emissions inevitably increase by greater amounts than NO_2 concentrations due to the additional presence of NOx. Therefore it is considered that the significance criteria are inappropriate for use on NOx assessments and, in the absence of any suitable significance criteria for this assessment, professional judgement has been used to assess these impacts.

Table 16.6 Descriptors of impacts at individual receptors

<table>
<tr><th rowspan="2">Concentration relative to Objectives</th><th colspan="4">Magnitude of Change</th></tr>
<tr><th>Imperceptible</th><th>Small</th><th>Medium</th><th>Large</th></tr>
<tr><td colspan="5">Increase with scheme</td></tr>
<tr><td>Above Standard With Scheme (>100% of limit)</td><td rowspan="4">Negligible</td><td rowspan="2">Minor adverse</td><td rowspan="2">Moderate adverse</td><td>Major adverse</td></tr>
<tr><td>Just Below Standard With Scheme (90-100%)</td><td>Moderate adverse</td></tr>
<tr><td>Below Standard With Scheme (75-90%)</td><td rowspan="2">Negligible</td><td>Minor adverse</td><td rowspan="2">Minor adverse</td></tr>
<tr><td>Well Below Standard With Scheme (<75%)</td><td>Negligible</td></tr>
<tr><td colspan="5">Decrease with Scheme</td></tr>
<tr><td>Above Standard Without Scheme (>100% of limit)</td><td rowspan="4">Negligible</td><td rowspan="2">Minor beneficial</td><td rowspan="2">Moderate beneficial</td><td>Major beneficial</td></tr>
<tr><td>Just Below Standard Without Scheme (90-100%)</td><td>Moderate beneficial</td></tr>
<tr><td>Below Standard Without Scheme (75-90%)</td><td rowspan="2">Negligible</td><td>Minor beneficial</td><td rowspan="2">Minor beneficial</td></tr>
<tr><td>Well Below Standard Without Scheme (<75%)</td><td>Negligible</td></tr>
</table>

Note: The terminology applied in Table 16.6 differs from that published by the IAQM The phrases used are directly equivalent i.e. minor=slight; major=substantial.

16.4 Baseline conditions

16.4.1 Meteorological conditions

16.4.1.1 Local meteorological conditions strongly influence the dispersion of pollutants, in particular the potential for any site to emit dust. Rainfall, in particular, decreases dust emissions due to both surface wetting and increasing the rate at which airborne dust is removed from air. In contrast, strong drying winds increase the rate at which dust is lifted from an untreated surface and emitted into the air, and also has the effect of spreading dust over a larger area.

16.4.1.2 A single year of hourly sequential meteorological data from Pembrey Sands has been used in the modelling study, (which is situated 35km southwest of the Project and with similar topographical features), for the year 2012, consistent with the most recent 2013 monitoring data available in the vicinity of the Project.

16.4.1.3 A surface roughness of 0.5 m was applied in the ADMS-Road model for road traffic (0.2 m at the meteorological measurement site) and with a Monin-Obukhov length of 30 m[3].

16.4.1.4 Analysis of the chosen meteorological data demonstrated that the area of the Project is subject to winds blowing most frequently from the west and south-west, with additional easterly winds throughout the rest of the year (Figure 16.2).

[3] The Monin-Obukhov length provides a measure of the stability of the atmosphere. A value of 30 m is representative of the conditions in the study area.

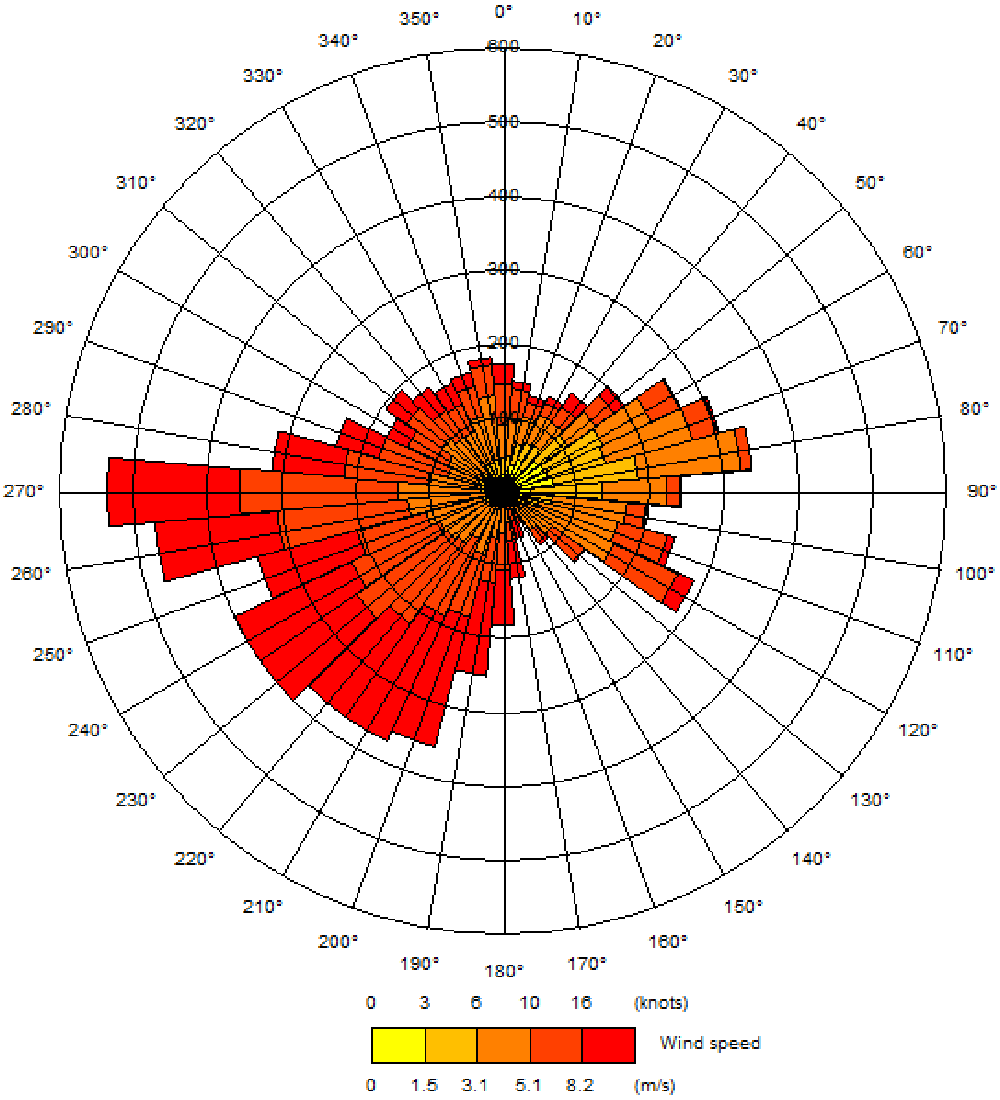

Figure 16.2 Wind Rose for Pembrey Sands (2012), illustrating the frequency that winds blew from each direction and the speed of those winds

16.4.2 Odour

16.4.2.1 In August 2013, the number of complaints relating to odour in the Swansea Dock area were requested from NPTCBC and CCSC for the preceding 5 year period. Records received from CCSC[4] showed a total of 51 complaints had been recorded during the 5 year period. NPTCBC noted that recent complaints of odour were located to the north-east of the Waste Water Treatment Works (WWTW) and were attributed to the WWTW due to the wind direction during that period. However a dataset of complaints outside the borough boundaries was not available[5].

16.4.2.2 The available evidence indicates that impacts of existing activities in the area are unlikely to emit odorous substances which would affect future users of the site. The WWTW is situated to the north-east of the Project site, and hence will be upwind of the Project when the wind is blowing from the west and south-west, which occurs most frequently throughout the year.

16.4.3 Local Air Quality Monitoring data

16.4.3.1 Baseline pollutant concentrations are the combined result of background air quality, which is representative of ambient air away from any major sources of pollution in the local area, and local emissions sources such as roads or industrial point sources.

16.4.3.2 NPTCBC first declared an AQMA within its administrative area due to exceedances of the 24 hour PM_{10} objective between the Tata Steel Works and the M4 motorway in 2000, approximately 6km to the south-east of the Lagoon (NPTCBC, 2013). The neighbouring administrative area of Swansea has also declared an AQMA known as the Swansea AQMA 2010 for potential exceedances of the mean annual NO_2 objective. The AQMA includes three areas, Sketty, Fforestfach and Hafod, the latter of which is located approximately 2km to the north-west of the Project boundary, predominantly on the west bank of the Tawe river, but bordering Pentreguinea Road.

16.4.3.3 A review of baseline monitoring data in the area has identified that the Project does not lie within an AQMA.

16.4.3.4 Table 16.7 summarises air quality monitoring data recorded in 2012 in the vicinity of the Project. A number of automatic monitoring stations are situated in the Swansea area, all of which are north-west of the Project boundary. CCSC have three diffusion tubes located on Fabian Way and three on Delhi Street, which runs parallel with and 150-200m north of Fabian Way, east of the Tawe river. The locations of these monitoring sites are shown on Figure 16.1, Volume 2.

16.4.3.5 The Swansea Hafod automatic monitoring station is situated within the Hafod AQMA, where an annual mean NO_2 concentration of 52.6 $\mu g/m^3$ was recorded in 2012, above the annual mean objective of 40 $\mu g/m^3$. This station is approximately 6km from the north western border of the Project. At all other automatic monitoring stations, concentrations were well below the objectives for NO_2 and for levels of PM_{10} and $PM_{2.5}$, which are recorded at the Swansea Automatic Urban and Rural Network (AURN) site (run on behalf of DEFRA and the Welsh Government).

[4] Email communication with Phil Govier; 13th August 2013.
[5] Telephone conversation with Simon Evans (NPTCBC); 27th August 2013.

16.4.3.6 Closer to the Project site, NO_2 diffusion tube monitoring on Delhi Street was well below the annual mean objective in 2012, as were two of the three monitoring sites on Fabian Way. However, a local exceedance of the annual mean NO_2 objective was recorded at diffusion tube SCC 291 in 2012, at a residential façade on the north side of Fabian Way, immediately east of the Park and Ride entrance (Table 16.7). Diffusion tube SCC 48 is located on the opposite side of the road, where annual mean NO_2 concentrations well below the annual mean objective, were recorded. Further consideration of the location of diffusion tube SCC 291 revealed that it is located close to a bus stop, and it is therefore likely to be affected by emissions from idling buses.

16.4.3.7 Monitoring locations are described as different types according to their proximity to the road and include background locations, roadside and kerbside (see Table 16.7). All monitoring locations close to the site of the Project are recorded as roadside locations. The measured baseline concentration at a roadside location is the sum of the contribution from background sources (the "background concentration") and the contribution from local sources, such as road transport sources. The concentration of road traffic emitted pollutants at the roadside or at sensitive receptors is influenced by a number of factors including background pollution levels and the amount of traffic emissions, which is dictated by traffic flow rates, composition and speed.

16.4.3.8 Concentration values for background sites are representative of the baseline conditions in their vicinity and can also be used to represent the background contribution to the total baseline at locations closer to the road.

16.4.3.9 In the absence of background monitoring locations in the vicinity of the study area (Cwm Level Park is situated 3.5 km north-west the Project site), concentrations of NO_X, NO_2, PM_{10} and $PM_{2.5}$ from the 2010 Defra Background Maps for 2012[6], from projected data and provided for the UK at a grid resolution of 1x1 km, have been applied as background concentrations in the modelling assessment, as shown in Table 16.8.

16.4.3.10 It should be noted that the measurement locations in Table 16.7 are closer to the road than the receptors specified in section 16.3.7.4. It would be expected that concentrations at receptors set further back from the road than these measurement locations would be lower than measured concentrations.

[6] http://laqm.defra.gov.uk/

Table 16.7 Local air quality monitoring data for 2012

Site	Location (x,y)	Type of sampler	Site type	2012 Annual Mean Concentration (µg/m^3)		
				NO_2	PM_{10}	$PM_{2.5}$
Swansea AURN	265322, 194447	Automatic Monitoring Station	Roadside	30.7	17.8	11.5
Swansea, Cwm Level Park	265914, 195896	Automatic Monitoring Station	Urban Background	19.6	NM	NM
Swansea, Morriston Ground Hog	267213, 197678	Automatic Monitoring Station	Roadside	28.1	13.9	NM
Swansea St Thomas DOAS	266192, 193650	Automatic Monitoring Station	Roadside	38.6	NM	NM
Swansea Hafod DOAS	265931, 194460	Automatic Monitoring Station	Roadside	52.6	NM	NM
SCC 35, Delhi Street	266314, 193298	NO_2 Diffusion Tube	Roadside	33.5	NM	NM
SCC 36, Delhi Street	266455, 193300	NO_2 Diffusion Tube	Roadside	31.7	NM	NM
SCC 38, Fabian Way	266662, 193181	NO_2 Diffusion Tube	Roadside	35.4	NM	NM
SCC 48, Fabian Way	268011, 193101	NO_2 Diffusion Tube	Roadside	23.5	NM	NM
SCC 102, Delhi Street	266379, 193307	NO_2 Diffusion Tube	Roadside	29.7	NM	NM
SCC 291, Fabian Way	267952, 193121	NO_2 Diffusion Tube	Roadside	45.2	NM	NM
Assessment Criteria				**40**	**40**	**25**

NM: Pollutants not monitored at this site

Table 16.8 Background air quality concentrations used in the assessment

Data source	Centre of 1x1 km grid square	2012 Annual mean concentration (µg/m^3)			
		NO_2	NOx	PM_{10}	$PM_{2.5}$
DEFRA 2010 Background Maps, 1x1 km resolution	266500, 193500	17.9	25.3	13.8	9.4
	267500, 193500	15.4	21.3	13.2	9.0
	268500, 193500	13.9	18.9	13.0	8.9
	269500, 192500	13.6	18.5	12.7	8.8
	270500, 193500	15.4	21.3	13.8	9.4
	271500, 193500	13.7	18.7	12.7	8.8

16.4.4 Model verification

16.4.4.1 Model verification has been informed by diffusion tube sampling undertaken by CCSC in the vicinity of the study area. Given the availability of local data it was not considered necessary to collect further diffusion tube data. The predicted pollutant concentrations reported in this assessment have been adjusted for model bias following the methodology described in LAQM.TG(09), and below.

16.4.4.2 The diffusion tubes located on Delhi Street were not used for verification, as traffic data for Delhi Street were not included in the model. Concentrations at diffusion tube SCC 291 are likely to have been affected by local emissions from idling buses. As this source was not explicitly defined in the model, the diffusion tube was also omitted from the verification process, and diffusion tubes SCC 38 and SCC 48 on Fabian Way were used.

16.4.4.3 The verification process has been undertaken following the methodology described in LAQM.TG(09). Modelled predictions were made for annual mean NO_2 concentrations at the locations of the diffusion tubes. Table 16.9 compares modelled and measured concentrations of NO_X and NO_2 before the model was adjusted for bias. Defra's 'NOx-to-NO_2 calculator v3.2' is used to estimate the equivalent measured NOx concentration from the reported NO_2 concentration at each measurement site. The measured NOx values are compared with the modelled NOx concentration values. Modelled concentrations of NO_2 were found to be underestimated at SCC 38 and SCC 48 by 24% and 10% respectively, therefore suggesting that the model is systematically underestimating.

Table 16.9 Summary of the verification procedure

Diffusion Tube	Measured Annual Mean NO_2 ($\mu g/m^3$)	Measured* Road Contribution NOx ($\mu g/m^3$)	Modelled Annual Mean NO_2 ($\mu g/m^3$)	% Difference Between Measured and Modelled NO_2
SCC 38	35.4	37.9	26.9	-24%
SCC 48	23.5	19.4	21.2	-10%

* 'Measured' NOx is derived from measured NO_2 using Defra's 'NOx-to-NO_2 calculator v3.2'.

16.4.4.4 To account for the identified model bias, and in accordance with LAQM.TG(09), modelled and measured NOx concentrations from the road contribution were directly compared, and the average adjustment factor for the two locations was calculated to be 1.77. The road NOx contribution predicted at all locations was adjusted by a factor of 1.77 to bring predicted total NO_2 concentrations in line with measured data. Comparison of bias adjusted predictions against measured values is shown in Figure 16.3, where the blue points represent the verified model, and the improved agreement with monitored data can be seen when compared with the unadjusted model (red points).

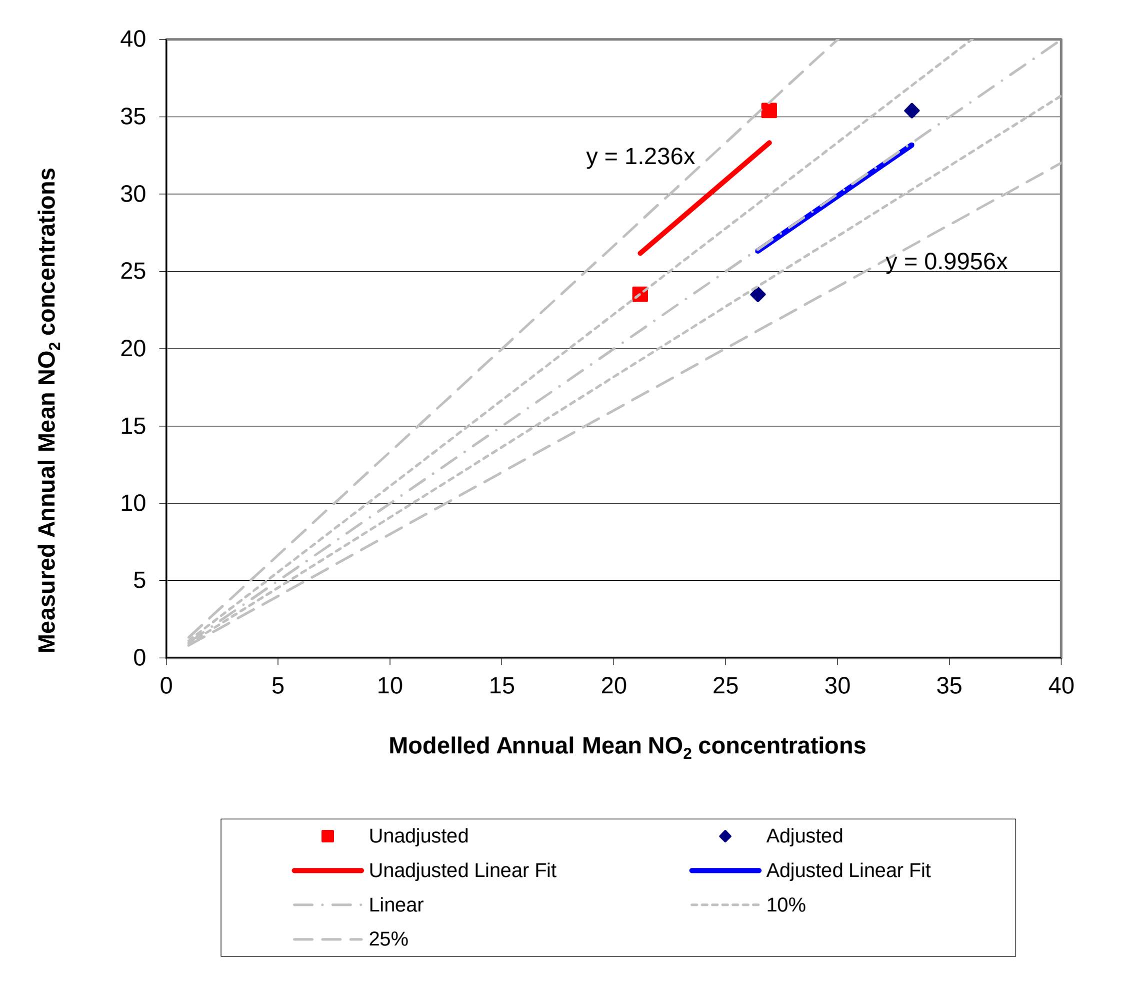

Figure 16.3 Comparison of measured and modelled nitrogen dioxide concentrations

16.4.4.5 In the absence of locally sampled PM_{10} and $PM_{2.5}$ data, the verification exercise described above is applied to annual mean primary pollutant concentrations for all of the selected receptors, as described in LAQM.TG(09).

16.4.5 Modelled existing baseline conditions

16.4.5.1 Table 16.10 presents the modelled baseline concentrations at the chosen receptor points, incorporating both background concentrations and local traffic emissions. These modelled concentrations are based on 2010 and 2013 traffic count data, scaled to 2012 traffic flows using the DfT's TEMPro (Trip End Model Presentation Program) adjustment factors. More information can be found in the Onshore Transport, Chapter 15. 2012 emission factors and 2012 background concentrations are employed, the latter of which are outlined in Table 16.8.

16.4.5.2 The modelled concentrations are currently expected to comply with the mean annual NO_2 Air Quality Strategy objective at all specified receptor points. NO_2 concentrations range from 15.8 µg/m^3 at Receptor 5 (Crymlyn Bog) to 25.3 µg/m^3 at Receptor 7 (the corner between Sebastopol Street and Fabian Way).

16.4.5.3 In addition to comparison of modelled NO_2, PM_{10} and $PM_{2.5}$ concentrations against the objectives set for the protection of human health, modelled annual mean NOx concentrations are also presented in Table 16.10 for comparison with the objective set for the protection of vegetation and ecosystems – the Critical level – at Receptor 3 (Crymlyn Bog) and Receptors 4 and 5 (Crymlyn Burrows). This objective is not applicable at the remaining receptors, therefore modelled values are not presented for these receptors. Critical levels are defined as "*concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge*"[7].

Table 16.10 2012 modelled baseline pollutant concentrations (µg/m^3)

Receptor	Annual mean NOx	Annual mean NO_2	Annual mean PM_{10}	Annual mean $PM_{2.5}$	No days PM_{10}>50µg/m^3
Receptor 1	n/a	19.1	13.6	9.4	<1
Receptor 2	n/a	20.7	14.8	10.0	<1
Receptor 3	35.8	22.6	15.2	10.3	<1
Receptor 4	31.2	20.1	13.9	9.5	<1
Receptor 5	22.2	15.8	13.9	9.4	<1
Receptor 6	n/a	25.3	15.3	10.4	<1
Receptor 7	n/a	24.2	15.0	10.2	<1
Assessment Criteria	30	40	40	25	35

Note: n/a denotes air quality objective is not applicable at these receptors. The annual mean NOx objective is set with the aim of protecting ecosystems and vegetation, whilst objectives for NO_2, PM_{10} and $PM_{2.5}$ are set for the protection of human health.

16.4.5.4 With regard to exceedances of short-term NO_2 from road traffic emissions, LAQM.TG(09) states that "…*authorities may assume that exceedances of the 1-hour mean objective for NO_2 are* unlikely *to occur where annual mean concentrations are 60 µg/m^3 or below*". The modelled annual mean NO_2 concentrations are below 60 µg/m^3 at all of the receptors and are therefore expected to comply with this objective.

16.4.5.5 Similarly, modelled PM_{10} and $PM_{2.5}$ concentrations are expected to easily comply with the mean annual (PM_{10} and $PM_{2.5}$) and 24 hour (PM_{10}) national Air Quality Strategy objectives for the 2012 baseline (see Table 16.2).

16.4.5.6 Annual mean NOx concentrations at Crymlyn Burrows (Receptors 3 and 4) are respectively 19% and 4% over the annual mean objective of 30 µg/m^3 for vegetation and ecosystems (critical level).

16.4.6 Modelled future baseline conditions

16.4.6.1 It is also important to understand the future baseline conditions, in order to make a direct comparison of air quality with and without the Project during the period of peak construction and, if necessary, the operational phase when sporting events may lead to additional traffic flows. The main construction phase is anticipated to start in spring 2015 and will last about three years, with the first power generated anticipated to be in summer 2018. Finishing works will continue to the beginning of 2019, such that all works are complete.

16.4.6.2 The predicted concentrations at the chosen receptor points in 2018, incorporating both background concentrations and local traffic emissions, are presented in Table 16.11. The future baseline scenario is based on 2018 traffic flows, and 2012 background concentrations and emission factors.

[7] http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm

16.4.6.3 The overall picture for the future baseline scenario is generally of good air quality at all receptors (R1 to R7) when compared with the national air quality objectives set for the protection of human health, with the annual mean air quality objective values for nitrogen dioxide, PM_{10} and $PM_{2.5}$ all predicted to be achieved by a large margin.

16.4.6.4 However, annual mean NOx concentrations at Crymlyn Burrows (Receptors 3 and 4) are respectively 22% and 32% above the annual mean objective of 30 μg/m^3 for vegetation and ecosystems. The predicted concentration at Crymlyn Bog (Receptor 5) is well below the objective.

Table 16.11 Predicted pollutant concentrations (μg/m^3) for the future baseline scenario

Receptor	Annual mean NOx	Annual mean NO_2	Annual mean PM_{10}	Annual mean $PM_{2.5}$	No days PM_{10}>50μg/m^3
Receptor 1	n/a	19.4	13.7	9.4	<1
Receptor 2	n/a	21.3	15.0	10.1	<1
Receptor 3	36.7	23.0	15.3	10.4	<1
Receptor 4	39.7	24.2	14.2	9.7	<1
Receptor 5	22.3	15.9	13.9	9.4	<1
Receptor 6	n/a	25.7	15.4	10.4	<1
Receptor 7	n/a	24.6	15.0	10.2	<1
Assessment Criteria	**30**	**40**	**40**	**25**	**35**

Note: n/a denotes air quality objective is not applicable at these receptors. The annual mean NOx objective is set with the aim of protecting ecosystems and vegetation, whilst objectives for NO_2, PM_{10} and $PM_{2.5}$ are set for the protection of human health.

16.4.7 Effects at ecological sites

16.4.7.1 The background nitrogen deposition flux has been taken from the map of total nitrogen deposition[8] as well as the APIS Simple Site based Assessment for heathland, marshland, scrub and grassland[9]. The APIS deposition rate for 2009-11 is 10.78 kg N/ha/year. This is reduced by 2% each year (taking the APIS value as a 2010 value) to estimate the deposition rate for the assessment year, 2018, of 9.17 kg N/ha/year.

16.4.7.2 Critical loads exist for nitrogen deposition at both Crymlyn Bog and Crymlyn Burrows. The critical load for Transition Mire and Quaking Bogs, which is the most sensitive habitat within Crymlyn Bog, is 5-10 kg N/ha/yr. This is based on the habitat type 'Raised bog and blanket bog' (APIS, 2013). The critical load for sand dune habitat, which is the most sensitive habitat within Crymlyn Burrows SSSI, is 8-15 kg N/ha/yr.

16.4.7.3 Defra exceedance maps for saltmarsh for the UK do not show any exceedances for nitrogen deposition in the vicinity of the Project Site.

[8] http://pollutantdeposition.defra.gov.uk/
[9] http://www.apis.ac.uk

16.4.8 Crymlyn Bog

16.4.8.1 The 2018 baseline nitrogen deposition rate at Receptor 5 is calculated to be 9.2 kg N/ha/year. This is within the range of the critical load for Crymlyn Bog.

16.4.9 Crymlyn Burrows SSSI

16.4.9.1 The 2018 baseline nitrogen deposition rate at Receptor 3 is calculated to be 9.9 kg N/ha/year. This is within the range of the critical load for Crymlyn Burrows.

16.4.9.2 The 2018 baseline nitrogen deposition rate at Receptor 4 is calculated to be 10.0 kg N/ha/year. This is within the range of the critical load for Crymlyn Burrows.

16.5 Potential impacts and mitigation measures

16.5.0.1 This section presents the assessment of the impacts associated with the various phases of the Project, i.e. construction, operation and decommissioning. The assessment has been undertaken with the Project incorporating appropriate mitigation, in line with good assessment practice, as recommended by the IAQM. Additional site specific measures are identified.

16.5.0.2 Impacts upon air quality may be expected from any activities which have the potential to change emissions. This includes onshore construction works, grid connection, and any changes in traffic movements.

16.5.1 Construction phase

16.5.1.1 This section presents the potential impacts associated with the construction, pre-commissioning and commissioning phase of the Project. The preparation of the landside site set up will be from March to October 2015. The main construction phase is anticipated to start in spring 2015 and will last about three years, with the first power generated anticipated to be in summer 2018. Finishing works will continue to the beginning of 2019, such that all works are complete. Further details of the construction programme are provided in Chapter 4: Project Description.

16.5.2 Construction road traffic emissions

16.5.2.1 The potential effect of the additional road traffic, including HGVs associated with construction has been assessed using the air quality dispersion model, ADMS-Roads. Car journeys by workers arriving and leaving the Project have also been included. The main construction works is estimated to begin in 2015 and finish in 2018. In the interest of modelling the worst case scenario, peak construction has been modelled against the baseline year of 2012 (in other words not including any improvements in background air quality or vehicle emissions between the present-day and construction). As vehicle emission factors are expected to decline in future years, this is likely to lead to a cautious estimate of the actual concentrations during the peak construction period.

16.5.2.2 The modelled concentrations due to the additional road traffic associated with the construction phase, shown in Table 16.12, do not include the effects of site plant exhaust emissions or construction dust generation. Modelled concentrations of NO_2, PM_{10} and $PM_{2.5}$ are well below the respective objectives at all receptor locations (see Table 16.4).

Table 16.12 Modelled pollutant concentrations (µg/m³) for the construction phase

Receptor	Annual mean NOx	Annual mean NO_2	Annual mean PM_{10}	Annual mean $PM_{2.5}$	No days PM_{10}>50µg/m³
Receptor 1	n/a	19.7	13.7	9.4	<1
Receptor 2	n/a	21.5	15.0	10.1	<1
Receptor 3	37.5	23.4	15.4	10.4	<1
Receptor 4	41.1	24.8	14.3	9.8	<1
Receptor 5	22.3	15.9	13.9	9.4	<1
Receptor 6	n/a	25.8	15.4	10.4	<1
Receptor 7	n/a	24.7	15.0	10.2	<1
Assessment Criteria	**30**	**40**	**40**	**25**	**35**

Note: n/a denotes air quality objective is not applicable at these receptors. The annual mean NOx objective is set with the aim of protecting ecosystems and vegetation, whilst objectives for NO_2, PM_{10} and $PM_{2.5}$ are set for the protection of human health.

16.5.2.3 Table 16.13 presents the magnitude of the change in pollutant concentrations resulting from the change in road traffic flows during the construction phase of the Project, relative to the baseline concentrations (Table 16.10). It should be noted that all impacts are temporary and restricted to the construction phase of the Project.

Table 16.13 Modelled impact of the construction phase

Receptor	Annual mean NOx	Annual mean NO_2	Annual mean PM_{10}	Annual mean $PM_{2.5}$	No days PM_{10}>50µg/m³
Receptor 1	n/a	0.3 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 2	n/a	0.2 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 3	0.8 (s)	0.4 (s)	0.1 (i)	<0.1 (i)	<1 (i)
Receptor 4	1.4 (s)	0.6 (s)	0.1 (i)	0.1 (i)	<1 (i)
Receptor 5	<0.1 (i)	<0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 6	n/a	0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 7	n/a	0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)

Note: Magnitude of change displayed in parentheses: (i) imperceptible, (s) small, (m) medium, (l) large (Table 16.5).

16.5.2.4 With regard to particulate matter, increases of an imperceptible magnitude are modelled at all receptors. The impact on nitrogen dioxide concentrations is imperceptible at Receptor 5, and small at all other receptor locations (greatest increase of 0.6 µg/m³ at Receptor 4 (south of Fabian Way/Fford Amazon roundabout at the northern boundary of Crymlyn Burrows). Imperceptible and small impacts are **negligible**, which is **not significant**.

16.5.2.5 Annual mean NOx concentrations at Crymlyn Burrows (Receptors 3 and 4) are respectively 25% and 37% over the annual mean objective of 30 µg/m^3 for vegetation and ecosystems. The predicted concentration at Crymlyn Bog (Receptor 5) remains well below the objective.

16.5.2.6 In accordance with paragraph 16.3.9.5, professional judgement has been employed to assess the significance of the impact upon NOx concentrations during the construction phase. As the increases in NOx are short-term and temporary and will drop off with distance from the road, the impacts are considered to be **minor** and **not significant**.

16.5.3 Crymlyn Bog

16.5.3.1 The 2018 baseline nitrogen deposition rate at Receptor 5 of 9.2 kg N/ha/year would increase by less than 0.1 kg N/ha/year as a result of road traffic associated with the construction phase of the Project. The impact on the rate of deposition will be short term and temporary as the main construction phase is scheduled to be completed by 2018. There will be no further deposition of nitrogen as a result of emissions from these activities. This temporary effect is **not significant**.

16.5.4 Crymlyn Burrows SSSI

16.5.4.1 The 2018 baseline nitrogen deposition rate at Receptor 3 of 9.9 kg N/ha/year would increase by less than 0.1 kg N/ha/year as a result of road traffic associated with the construction phase of the Project. The impact on the rate of deposition will be short term and temporary as the main construction phase is scheduled to be completed by 2018. There will be no further deposition of nitrogen as a result of emissions from these activities. This temporary effect is not considered to be significant.

16.5.4.2 The 2018 baseline nitrogen deposition rate at Receptor 4 of 10.0 kg N/ha/year would increase by less than 0.1 kg N/ha/year as a result of road traffic associated with the construction phase of the Project. The impact on the rate of deposition will be short term and temporary as the main construction phase is scheduled to be completed by 2018. There will be no further deposition of nitrogen as a result of emissions from these activities. This temporary effect is **not significant**.

16.5.5 Construction plant exhaust emissions

16.5.5.1 With regard to the onshore construction equipment, there will be relatively few vehicles/plant present onshore at any one time, and the total number of vehicles used, as presented in Table 16.14, will be relatively small compared to background traffic levels in the area.

Table 16.14 Onshore plant to be used during wall construction

Plant type	Quantity
40-120t Excavator	10
Wheeled Loaders	5
Dump Trucks	10
Bulldozers	4

16.5.5.2 It is expected that potential effects on NO_2 concentrations will typically range from minor adverse at the site boundary, reducing to negligible within 15-20m of the boundary. At present, PM_{10} emissions are typically negligible at the boundary of the working spread. It is expected that the effect associated with the Project will therefore be minor, due to the relatively small number of construction works expected on site. Furthermore, a series of mitigation measures to secure adherence to the IAQM guidance is presented later in this chapter to minimise the effect as far as reasonably possible.

16.5.5.3 The construction of the permanent Lagoon seawall and temporary cofferdam bund will require the offshore plant and vessels listed in Table 16.15.

Table 16.15 Offshore plant/vessels to be used during wall construction

Offshore plant/vessels Type	Quantity
Cutter Dredger	1 or 2
Backhoe Dredger	2
Split Barge	4 to 6
Side Stone Dumping Vessel	2
Rock Barge	4
Tug	4 or 5
Multicat	1 or 2
Survey Launch	1
Crew Launch	1

16.5.5.4 It is expected that one dredger will be used for the construction of the permanent bund, whilst an additional smaller dedicated dredger may be required for the temporary bund.

16.5.5.5 It is planned that delivery of rock to the site for the construction of the bunds will be by sea. The maximum number of barges operating during the construction phase of the Lagoon wall will be ten per week during April 2015, at the beginning of the construction of Phase 1 – Western Arm and the Temporary Bund.

16.5.5.6 The onshore and offshore plant and vessels are unlikely to result in a significant change in ambient air quality concentrations at the closest sensitive receptors. Therefore, a detailed air quality assessment is judged not to be necessary as the setting of the works is within and adjacent to the working Port, the number of construction plant and vessels is small compared to the activity at the Port and the works take place in excess of 100m from any sensitive receptors.

16.5.6 Construction dust generation

16.5.6.1 With regard to construction dust, the movement of soils and rubble during construction activities, including grid connection works, is anticipated to lead to the generation of airborne dust and particulates. The occurrence and significance of dust generated by earth moving operations is extremely difficult to estimate, and depends upon meteorological and ground conditions at the time and location of earth working.

16.5.6.2 The potential effects of construction dust are three-fold: as an effect on amenity through the soiling of property, through the deposition of material on vegetation, and as having the potential to cause human health effects.

16.5.6.3 For amenity effects (including that of dust), the aim is to bring forward a scheme, if necessary including mitigation measures, that does not introduce the potential for additional complaints to be generated as a result of the Project.

16.5.6.4 Table 16.16 shows the descriptors that are applied to the predicted adverse effects of fugitive emissions. Experience in the UK (IAQM, 2012) is that good site practice is capable of mitigating the impact of fugitive emissions of particulate matter effectively. So that in all but the most exceptional circumstances, effects at receptors can be controlled to ensure effects are of **negligible** or **slight adverse significance**.

Table 16.16 Descriptions applied to the predicted adverse effects of fugitive emissions of particulate matter

Significance of Effect at Single Receptor	Description
Substantial	A significant effect that is likely to be a material consideration in its own right.
Moderate	An significant effect that may be a material consideration in combination with other significant effects, but is unlikely to be a material consideration in its own right
Slight	An effect that is not significant but that may be of local concern
Negligible	An effect that is not significant change

16.5.6.5 The closest receptor in terms of amenity and potential health effects to the construction site and access is Receptor 2 on Fabian Way. The closest ecological receptor is Crymlyn Burrows (Receptor 4), adjacent to the eastern boundary of the site.

16.5.7 Demolition

16.5.7.1 The majority of the existing 2m seawall (approximately 2.5 km) will be demolished prior to the commencement of the landworks (potentially with some sections being retained for archaeology). The eastern port pier will also be demolished and disposed of. The existing disused steel framed building at the western landfall will also be dismantled (Chapter 18, Land Quality and Hydrogeology). The nearest receptor in the prevailing wind direction (Receptor 1) is situated over 300m to the east of the existing structure and is therefore unlikely to be affected by the demolition works.

16.5.7.2 Nevertheless, mitigation measures considered good practice include:

i. agree lines of communication between local authority pollution control officer and contractor(s) prior to commencement of works and procedure for reporting dust events or complaints from local residents;

ii. demolition undertaken in a phased and controlled manner, especially at locations within 100 m of nearest receptors;

iii. regular inspections of works for visible signs of emissions of dust and early application of measures to minimise emissions at source;

iv. considerate location of temporary storage of dusty materials and material transfer operations on land that is not between site access and nearest receptors; and

v. operation of mobile crushing plant to requirements of permit.

16.5.7.3 With good site practice, the demolition works will have a negligible effect on amenity and short term PM_{10} concentrations at all receptors, which is **not significant.**

16.5.8 Earthworks

16.5.8.1 Site clearance works, the digging of trenches, temporary stockpiling of material and construction of the bunds represent the principal activities that may generate emissions of particulate material during the construction of the Project, including grid connection works.

16.5.8.2 The potential for stockpiles of materials to generate dust depends on the nature of the material. Earth is soft and friable compared to hardcore. However, hardcore generally has a lower moisture content than soil, and consequently both can be potential sources of dust.

16.5.8.3 Mitigation measures considered good practice include:

I. Agree lines of communication between local authority pollution control officer and contractor(s) prior to commencement of works and procedure for reporting dust events or complaints from local residents;
II. During extended periods of dry weather (especially over holiday periods) plan for additional mitigation measures to avoid wind blown dust issues both within and outside normal working hours; and
III. Avoid long term stockpiles of material on site without application of measures to stabilise the material surface, such as application of suppressants or seeding.

16.5.8.4 The risk of amenity effects and the amount of mitigation effort required is strongly influenced by weather conditions at the time of the works. With good site practice the earthworks would have a **negligible to slight effect** on amenity and a **negligible effect** on short term PM_{10} concentrations at all receptors.

16.5.9 Construction

16.5.9.1 Dust emissions during construction can give rise to elevated dust deposition and PM_{10} concentrations. These are generally short-lived changes over a few hours or days, which occur over a limited time period of several weeks or months.

16.5.9.2 Placing activities which are a potential source of PM_{10} such as cutting and grinding of materials and cement mixing away from boundaries, would minimise the possibility of exposure to PM_{10} at receptors within 100 m of the site boundary.

16.5.9.3 Good site practice measures during this phase of the Project are similar to those described above, which will be adopted during this phase where relevant. In addition further measures which should also be considered include:

i. construction of any site roads early enough to avoid the use of haul routes on site; and
ii. adoption of mobile booths for cutting and grinding operations if work cannot be undertaken away from sensitive receptors.

16.5.9.4 With good site practice the construction works would have a negligible effect on amenity and on short term PM_{10} concentrations at all receptors. Such measures will be secured by the CEMP associated with the Project (see further below) consequently, this is **not significant**.

16.5.10 Track-out of material

16.5.10.1 Facilities for the washing of vehicles and vehicle wheels could provide an appropriate means of minimising the potential for material to be transferred onto the local road network. However, the use of washing also leads to wetting of local roads near the access and can, if not carefully managed, spread material further along the local road network.

16.5.10.2 Once on-site roads have been constructed, wheel washing provides less benefit and is not recommended. However regular inspection of the local roads within 200 m of the site access point(s) should be undertaken and street cleaning applied as necessary.

16.5.10.3 The effect of track-out of material can be minimised by limiting the amount of material transferred onto local roads and by removal of any transferred material from the roads.

16.5.10.4 With good site practice track-out of material has been determined by the IAQM to have a negligible effect on short term PM_{10} concentrations and amenity at all receptors. This is **not significant.**

16.5.11 Combined construction effects

16.5.11.1 The HGV, site plant and dust generation together are not expected to lead to any effects of greater significance than those highlighted above when considering each individually. Overall the effects of the construction phase activities are considered to be negligible, which is not considered to represent a significant effect.

16.5.12 Mitigation measures for the construction phase

16.5.12.1 A CEMP will be prepared for the site and agreed with CCSC and NPTCBC before any on-site works begin. The CEMP is presented in Appendix 4.1, Volume 3.

16.5.12.2 The following section presents a list of some of the typical mitigation measures that are likely to be among those implemented, where appropriate, during the construction phase as part of the CEMP.

16.5.12.3 Construction vehicle emissions would be minimised or through:

I. The use of catalytic converters and other emissions controls devices and regular maintenance of vehicle engines;

II. On-road vehicles to comply with national and EU emission standards; and

III. All vehicles will switch off engines when not in use no idling vehicles.

16.5.12.4 The main onshore works will be within the working Swansea Port and, as such, dust is not anticipated to be a significant issue because of the distance from sensitive receptors. Works adjacent to the eastern seawall landfall would be close to the SUBC (currently under construction) and therefore would be potentially more sensitive. Construction dust and vehicle track out is expected to only represent a short-term and temporary nuisance to exposed human receptors in immediate proximity to the construction site and would be controlled through the application of a series of best practice measures which could include, but not necessarily limited to:

i. No bonfires;

ii. Site layout will be planned – machinery and dust causing activities will be located away from sensitive receptors where possible;

iii. Reduce speeds of vehicles tracking across unmade surfaces;

iv. Use of water as a dust suppressant where appropriate during dry weather;

v. Minimise drop heights for delivery of aggregates; and

vi. Regular vehicle cleaning and covered loads.

16.5.13 Operational phase - operational road traffic

16.5.13.1 A detailed assessment of the potential impact of road traffic emissions has been undertaken for the operational phase of the Project. The assessment considers the potential effects from road vehicles associated with routine operation/maintenance and average visitor usage of the site as well as significant sporting events held at the Lagoon.

16.5.13.2 Table 16.17 presents the modelled concentrations of NO_2, and particulate matter when the Project is operational in 2018. All concentrations at all receptors remain well below the respective air quality objectives for NO_2, PM_{10} and $PM_{2.5}$.

16.5.13.3 Annual mean NOx concentrations at Crymlyn Burrows (Receptors 3 and 4) are respectively 23% and 33% over the annual mean objective of 30 µg/m^3 for vegetation and ecosystems. The predicted concentration at Crymlyn Bog (Receptor 5) remains well below the objective.

Table 16.17 Modelled pollutant concentrations (µg/m^3) for the operational Project

Receptor	Annual mean NOx	Annual mean NO_2	Annual mean PM_{10}	Annual mean $PM_{2.5}$	No days PM_{10}>50µg/m^3
Receptor 1	n/a	19.5	13.7	9.4	<1
Receptor 2	n/a	21.3	15.0	10.1	<1
Receptor 3	36.8	23.1	15.3	10.4	<1
Receptor 4	39.8	24.2	14.2	9.8	<1
Receptor 5	22.3	15.9	13.9	9.4	<1
Receptor 6	n/a	25.7	15.4	10.4	<1
Receptor 7	n/a	24.6	15.0	10.2	<1
Assessment Criteria	**30**	**40**	**40**	**25**	**35**

16.5.13.4 Table 16.18 shows that the impact of road traffic associated with the operational phase of the Project on air quality is imperceptible at all of the selected sensitive receptors for NOx, $NO_2$and particulate matter. These impacts are negligible, and are not considered to be significant.

Table 16.18 Modelled impact of the operational Project

Receptor	Annual mean NOx	Annual mean NO_2	Annual mean PM_{10}	Annual mean $PM_{2.5}$	No days PM_{10}>50µg/m^3
Receptor 1	n/a	0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 2	n/a	<0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 3	0.1 (i)	0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 4	0.1(i)	<0.1 (i)	<0.1 (i)	0.1 (i)	<1 (i)
Receptor 5	<0.1 (i)	<0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 6	n/a	<0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)
Receptor 7	n/a	<0.1 (i)	<0.1 (i)	<0.1 (i)	<1 (i)

Note: Magnitude of change displayed in parentheses: (i) imperceptible, (s) small, (m) medium, (l) large (Table 16.5).

16.5.14 Crymlyn Bog

16.5.14.1 The 2018 baseline nitrogen deposition rate at Receptor 5 of 9.2 kg N/ha/year would not be increased during the operational phase of the Project, and therefore does not give rise to a significant effect. This remains within the range of the critical load for Crymlyn Bog.

16.5.15 Crymlyn Burrows SSSI

16.5.15.1 The 2018 baseline nitrogen deposition rate at Receptor 3 of 9.9 kg N/ha/year would not be increased during the operational phase of the Project, and therefore does not give rise to a significant effect. This remains within the range of the critical load for Crymlyn Burrows.

16.5.15.2 The 2018 baseline nitrogen deposition rate at Receptor 4 of 10.0 kg N/ha/year would not be increased during the operational phase of the Project, and therefore does not give rise to a significant effect. This remains within the range of the critical load for Crymlyn Burrows.

16.5.16 Mitigation measures for the operational phase

16.5.16.1 No additional mitigation measures are necessary for the operational phase of the Project.

16.5.17 Decommissioning phase

16.5.17.1 The Project is expected to have a lifetime of up to 120 years with appropriate maintenance. At this time, there are two options for the Project, either continuous up-grade or removal of turbine/sluice gates.

16.5.17.2 It is expected that the potential impacts associated with the decommissioning phase will be less than during construction and are expected to occur over a shorter timeframe. The underground cabling onshore would be left in place, thus avoiding the need to disturb those areas and cause unnecessary air and dust emissions. The impacts on air quality associated with the decommissioning phase are not likely to be significant.

16.6 Residual impacts

16.6.0.1 In line with the 2012 IAQM guidance – paragraph 1.3.1.9 – the assessment of significance of the construction phase has been undertaken assuming good site practice is in operation. As no additional site specific mitigation is recommended, the conclusions remain the same as the main assessment, and the construction of the Project will not result in a significant effect on air quality.

16.6.0.2 No mitigation measures in respect of air quality are proposed for the operational phase of the Project. As such, the conclusions remain the same as the main assessment. The operation of the Project will not give rise to any significant effects upon air quality.

16.7 Cumulative and in-combination impacts

16.7.0.1 This section presents the cumulative and in-combination impacts that arise as a result of the Project when considered along with other developments which are at the pre-planning stage, consented, or currently under construction.

16.7.0.2 A number of projects have been identified which require assessment in terms of cumulative effects, specified in Chapter 15: Onshore Transport. Consistent with the Transport Assessment, road traffic data associated with SUBC, SA1 and Coed Darcy Urban Village have been included in this assessment. Further information about these developments are presented in Chapter 2 of this ES. The magnitude of change in pollutant concentrations resulting from the change in traffic flows due to these developments and the operating Project, relative to baseline concentrations (Table 16.10) is presented.

16.7.0.3 Table 16.19 shows the modelled concentrations for the cumulative model at all receptors specified in section 16.3.7.4. Concentrations of $NO_2$and particulate matter are well below the annual mean objective at all of the selective receptors. The air quality impact of road traffic associated with the identified projects and the Project are presented in Table 16.20. The impact on PM_{10} and $PM_{2.5}$ is imperceptible at all receptors. The impact on NO_2 concentrations is at worst, small. The greatest impact is 1.1 $\mu g/m^3$ (a small impact) at Receptor 4. As the concentration at this receptor is well below the annual mean objective, the overall cumulative impact is negligible. This is not considered to be significant.

16.7.0.4 Annual mean NOx concentrations at Crymlyn Burrows (Receptors 3 and 4) are respectively 29% and 40% over the annual mean objective of 30 $\mu g/m^3$ for vegetation and ecosystems, the critical level. The predicted concentration at Crymlyn Bog (Receptor 5) remains below the objective. The increase in concentration attributable to the cumulative effects is considered to be minor and not significant.

Table 16.19 Modelled pollutant concentrations (µg/m³) for the cumulative effects (construction phase and committed developments)

Receptor	Annual mean NOx	Annual mean NO_2	Annual mean PM_{10}	Annual mean $PM_{2.5}$	No days PM_{10}>50µg/m³
Receptor 1	n/a	19.9	13.8	9.5	<1
Receptor 2	n/a	22.0	15.1	10.2	<1
Receptor 3	38.8	24.1	15.6	10.5	<1
Receptor 4	42.0	25.2	14.4	9.9	<1
Receptor 5	22.4	15.9	13.9	9.5	<1
Receptor 6	n/a	26.3	15.5	10.5	<1
Receptor 7	n/a	25.2	15.1	10.3	<1
Assessment Criteria	**30**	**40**	**40**	**25**	**35**

Table 16.20 Modelled impact of the cumulative effects (operational phase and committed developments)

Receptor	Annual mean NOx	Annual mean NO_2	Annual mean PM_{10}	Annual mean $PM_{2.5}$	No days PM_{10}>50µg/m³
Receptor 1	n/a	0.5 (s)	0.1 (i)	0.1 (i)	<1 (i)
Receptor 2	n/a	0.7 (s)	0.1 (i)	0.1 (i)	<1 (i)
Receptor 3	2.1 (s)	1.1 (s)	0.3 (i)	0.1 (i)	<1 (i)
Receptor 4	2.3 (s)	1.0 (s)	0.2 (i)	0.2 (i)	<1 (i)
Receptor 5	0.1 (i)	<0.1 (i)	<0.1 (i)	0.1 (i)	<1 (i)
Receptor 6	n/a	0.6 (s)	0.1 (i)	0.1 (i)	<1 (i)
Receptor 7	n/a	0.6 (s)	0.1 (i)	0.1 (i)	<1 (i)

Note: Magnitude of change displayed in parentheses: (i) imperceptible, (s) small, (m) medium, (l) large (Table 16.5).

16.7.1 Crymlyn Bog

16.7.1.1 The 2018 baseline nitrogen deposition rate at Receptor 5 of 9.2 kg N/ha/year would not be increased as a result of the operational phase of the Project and other committed developments, and therefore does not give rise to a significant effect.

16.7.2 Crymlyn Burrows SSSI

16.7.2.1 The 2018 baseline nitrogen deposition rate at Receptor 3 of 9.9 kg N/ha/year would increase by 0.1 kg N/ha/year to 10.0 kg N/ha/year as a result of road traffic associated with the operational phase of the Project and other committed developments. This change represents a 1.3 % increase of the lower critical load value (8 kg N/ha/year). As the change is at the lower end of the range at which an effect would be considered, a negligible effect would still be expected.

16.7.2.2 The 2018 baseline nitrogen deposition rate at Receptor 4 of 10.0 kg N/ha/year would increase by 0.2 kg N/ha/year to 10.2 kg N/ha/year as a result of road traffic associated with the operational phase of the Project and other committed developments. This change represents a 1.3 % increase of the lower critical load value (8 kg N/ha/year). As the change is at the lower end of the range at which an effect would be considered, a negligible effect would still be expected.

16.8 Summary

16.8.0.1 In general, construction activities have the potential to generate fugitive dust emissions as a result of demolition, construction, earth works or track-out of material. For the Project the concentrations of any airborne particulate matter generated by these activities will be controlled using on site management practices to the extent that the Project would give rise to effects of negligible significance on dust deposition rates at the nearest sensitive receptors. The impact of fugitive emissions of PM_{10} at these receptors with proposed mitigation applied will be negligible. Overall the effect of fugitive emissions of particulate matter (dust and PM_{10}) from the proposed works is considered to be not significant with respect to potential effects on health and amenity.

16.8.0.2 A qualitative assessment of the onshore and offshore plant and vessels that will be employed during the construction of the Project has been undertaken. The setting of the works is within and adjacent to the working Port. As the number of construction plant and vessels is small compared to the activity at the Port, and the works take place in excess of 100 m from any sensitive receptors, it is considered unlikely that the works will result in a significant change in ambient air quality concentrations at the closest sensitive receptors.

16.8.0.3 The advanced dispersion model ADMS-Roads has been used to quantify baseline pollutant concentrations at representative air quality sensitive receptors in the vicinity of the Project site, based on traffic data presented in Chapter 15 Onshore Transport. In the 2018 baseline scenario, the opening year, all receptors experience pollutant concentrations that are well below the respective national air quality standards. Annual mean NOx concentrations at Crymlyn Burrows are in excess of the annual mean objective during the 2018 baseline scenario.

16.8.0.4 The impact of road traffic associated with the construction phase of the Project has been assessed at sensitive receptors, and the greatest impact is predicted to be small. As the construction phase will be short term and temporary, and as the concentrations are well below the annual mean objectives, the overall impact is negligible. This is not considered to be significant.

16.8.0.5 With the Project in operation, all receptors will experience an imperceptible change in pollutant concentrations, thereby resulting in a negligible effect which is not considered to be significant.

16.8.0.6 This assessment has also qualitatively considered the cumulative effect of other developments at the pre-planning stage, consented, or currently under construction, as defined in the Transport chapter. The cumulative impact at sensitive receptors is predicted to be, at worst, small. As concentrations are well below the annual mean objectives, the overall cumulative impact is negligible. This is not considered to be significant.

16.8.0.7 As the potential impacts associated with the decommissioning phase are expected to be less than during construction and will occur over a shorter timeframe, the impacts on air quality associated with the decommissioning phase are not considered to be significant.

16.8.0.8 With regards to ecological sites, professional judgement has been applied to assess the significance of the impact upon NOx concentrations. Increases associated with increased road traffic during the construction and operational phases of the Project have been judged to be not significant, and will be no worse than without the Project in place. A quantitative assessment of nitrogen deposition at Crymlyn Bog and Crymlyn Burrows has been undertaken for the construction and operational phases of the Project. The results show that the impacts will be negligible and are not considered to be significant.

16.8.0.9 On balance, the overall effect of the Project will have a negligible effect and as such is considered to be not significant with regards to local air quality.

16.9 References

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