AIR QUALITY

OPERATIONAL PHASE – ASSESSMENT OF VEHICLE EXHUAST EMISSIONS

1 Introduction

1.1 The assessment of vehicle emissions associated with the Proposed Development has been undertaken in accordance with the IAQM guidance in relation to planning, air quality and human health[1] and ecological[2] receptors. Relevant receptors include residential dwellings, schools and hospitals, areas of leisure use and ecologically sensitive sites.

2 Screening Assessment

2.1 The level of assessment required was determined through an initial screening review considering the predicted vehicle movements in association with the proposed activities, the routing of vehicles along the roads within the transport assessment study area and locations of sensitive receptors.

2.2 The following criteria were used to determine potentially affected roads:

- LDV (Light Duty Vehicle) flow change by 500 AADT (annual average daily traffic) or more outside an AQMA (Air Quality Management Area), or 100 AADT or more within or adjacent to an AQMA;
- HDV (Heavy Duty Vehicle) flows change by 100 AADT or more outside an AQMA, or 25 AADT or more within or adjacent to an AQMA;
- Road alignment changing by 5m or more;
- Introduction or removal of a junction.

2.3 Where these criteria are met and there are relevant receptors present further assessment is required. This may take the form of a Simple or Detailed Assessment. The IAQM guidance does not specify at what distance a human health receptor should be to an affected road to indicate the need for further assessment. However, pollution concentrations fall rapidly away from the roadside and are expected to return to background levels within 100m of a road source[3]. For the purposes of the assessment reference is made to HE DMRB[4] guidance which requires assessment of receptors within 200m of affected roads.

[1] Institute of Air Quality Management (IAQM), Land-use Planning & Development Control: Planning for Air Quality. v1.2, 2017

[2] Institute of Air Quality Management (IAQM), A guide to the assessment of air quality impacts on designated nature conservation sites, version 1.0, June 2019

[3] Air Quality Consultants (AQC), NO_2 Concentrations and Distance from Roads, J504, 2008

4 Highways England (HE), Design Manual for Roads and Bridges (DMRB), Volume II Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1, HA 207/07, Air Quality, May 2007

2.4 Where there are no receptors within 200m of affected roads, these roads have not been considered further and potential impacts of vehicle emissions can be considered negligible and as having an insignificant effect.

2.5 Separate guidance is provided by Natural England (NE) in relation to ecological sites[5] and is re-iterated in IAQM guidance[2].

2.6 To assess whether further assessment in relation to ecological receptors was required reference was initially made to the following screening criteria:

- Total vehicle flow change by 1,000 AADT or more; or HDV flows change by 200 HGV AADT or more, where an ecological receptor is located within 200m of the affected road.

2.7 Full details on the screening assessment are provided in Chapter 6: Air Quality. In this case, the screening assessment concluded that further assessment of vehicle emissions was required with regards to human health receptors. Although consideration was made of ecological rectors, as discussed in Chapter 6, no further detailed assessment was deemed necessary.

3 Detailed Assessment – Human Health: Model-Set-Up

3.1 Model

3.1.1 ADMS-Roads (v4.1.1) was used to predict the changes in concentrations of the key pollutants associated with road transport, NO_2 and PM_{10}, due to the Proposed Development at selected receptors in proximity to the affected local road network.

3.2 Model Input Parameters

Traffic Data

3.2.1 The assessment has been based on the traffic data for the local road network as provided by Axis. The data has been provided as Annual Average Daily Traffic (AADT) traffic data and has been used to generate appropriate data for input into the ADMS-Roads model. Key data on the which the assessment has been based in provided in Appendix 6.4. For full details on which the basis the AADT traffic data has been derived should be made to the Transport Assessment.

3.2.2 The model has been based on individual road links as determined by the traffic data, layout information, observations of traffic flows and traffic lights. Where applicable roads, junctions and roundabouts have been sub-divided into detailed links and modelled with 2-way traffic flows

[5] Natural England (NE), Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations, v1.4 Final, June 2018

where applicable. Traffic speeds used in the model are based on site observations and Defra Guidance, particularly with respect to junctions and traffic lights[6].

Emission Factors

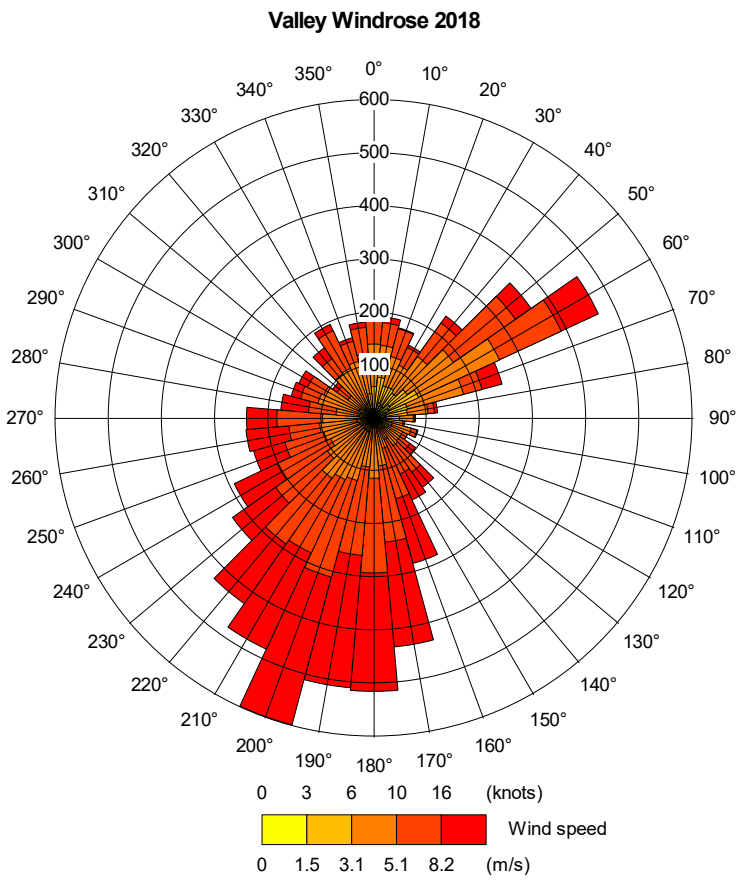
3.2.3 The ADMS-Roads v4.1.1 model incorporates the Emissions Factor Toolkit (EFTv9.0) issued by Defra in May 2019.

Meteorological Data

3.2.4 The dispersion modelling has been undertaken using 1 year of hourly sequential data from Valley (NGR: 230885 375849; 10m aod) provided by the Met Office, a recognised supplier of meteorological data. The monitoring station is located 8.94km to the southeast of the site at the Valley airfield. Data for 2018 has been used.

3.2.5 A windrose depicting wind speeds and directions derived from the data for 2018 is provided below.

Figure 3.1: Annual Windroses for Valley (year 2018)



[6] Department for Environment, Food and Rural Affairs (Defra), Local Air Quality Management (LAQM): Technical Guidance (TG16), February 2018

3.2.6 The general model conditions are summarised below:

Table 3.1: Model Conditions

Variables	Model Input
traffic data	derived from AADT data provided by Axis
emissions	NO_x, PM_{10}
emission factors	EFT 9.0; applied for each assessment year
emissions profiles	average throughout 24 hours
surface roughness at source	0.5m
meteorological data	1 year (2018) hourly sequential data for Valley
surface roughness at meteorological station	0.002m
minimum Monin-Obukov length	1m (default)
model output	long-term annual mean road-NO_x and road-PM_{10} concentrations
receptors	x, y coordinates, z = 1.5m (see Figure 2.1)

3.3 Modelled Scenarios

3.3.1 The assessment has considered the vehicle movements associated with the Proposed Development itself, and those calculated for existing committed developments in the area.

3.3.2 Defra EFT factors are only available up until 2030. The model has been run using appropriate EFT factors for 2024 and 2030 with 2024 and 2034 traffic data.

3.3.3 The model has been run for the following scenarios:

Table 3.2: ADMS-Roads Model Scenarios

Scenario	Year	Description
A	2019	Baseline traffic data
B	2024	'Do Nothing' / Future Baseline 2024; includes local committed developments
C		'Do Something' – Site Development 2024 (includes local committed developments)
D	2030	'Do Nothing' / Future Baseline 2030; includes local committed developments; uses 2034 traffic flows
E		'Do Something' – Site Development 2030 (includes local committed developments)

3.4 Modelled Receptors

3.4.1 Potential receptors were identified from site observations, a review of aerial photography and OS mapping, and with reference to the assessment work undertaken for the previous planning application. The majority of receptor locations represent residential building facades located

alongside the road network. These have been modelled at an elevation of 1.5m. Areas where short-term UK objectives may be relevant, i.e. areas where the members of the public may spend 1 hour or more, have also been included.

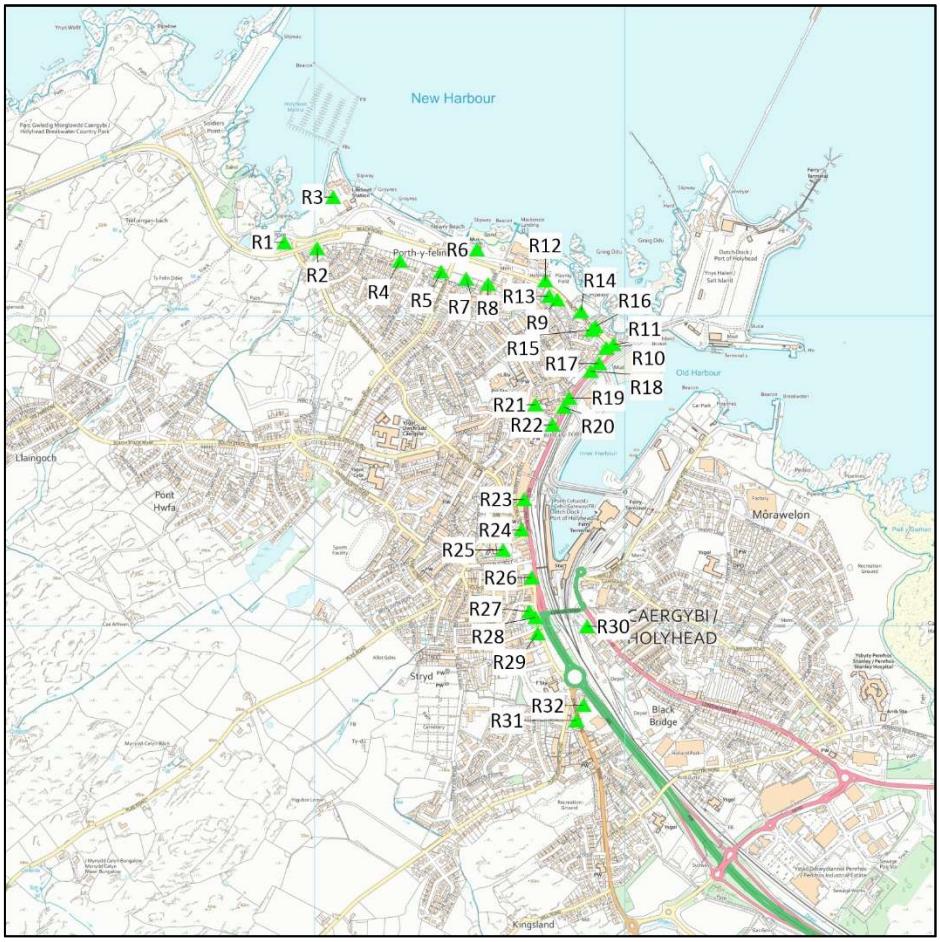
3.4.2 Receptors are identified as follows:

Table 3.3: Summary of Modelled Receptors

Receptors	Location	Comment
R1	The Boathouse Hotel	sensitive use
R2	Beach Road / unnamed road	residential use
R3	Holyhead Marina	residential use
R4	Beach Road	residential use
R5	Beach Road / Walthew Avenue	residential use
R6	Maritime museum	short-term leisure use
R7	St David's Road	residential use
R8	Newry Street	residential use
R9	Prince of Wales Road	residential use
R10	Prince of Wales Road	residential use
R11	Prince of Wales Road	residential use
R12	Playground	short-term leisure use
R13	Prince of Wales Road	residential use
R14	Allotments adjacent to Prince Wales Road	short-term leisure use
R15	Prince of Wales Road	residential use
R16	Prince of Wales Road	residential use
R17	Victoria Road	residential use
R18	Victoria Road	residential use
R19	Victoria Road	residential use
R20	Victoria Road	residential use
R21	Boston Street	Possible residential use
R22	Victoria Road	residential use
R23	Victoria Road	residential use
R24	Victoria Road	residential use
R25	St. Mary's School	school
R26	Victoria Road	residential use
R27	Victoria Road	residential use
R28	A55	residential use
R29	Hotel	sensitive use
R30	London Road	residential use
R31	Kingsland Road	residential use
R32	McDonald's	short-term leisure use including outdoor seating

3.4.3 Modelled receptor locations are provided below in Figure 3.2 and are discussed in greater detail in the Assessment section.

Figure 3.2: ADMS-Roads Modelled Receptors



3.5 Model Output and Verification

Model Verification

3.5.1 The model has been used to predict annual mean road contributions of concentrations of NO_2 and PM_{10} at the receptor facades.

3.5.2 Where possible it is usual practice to verify the model in accordance with Defra guidance[1]. This is done by comparing modelled data with monitored data and, where necessary, deriving an adjustment factor. No monitoring data is available within the vicinity of the Proposed Development or on the assessed road network and consequently model verification has not been undertaken.

Existing Baseline

3.5.3 Total annual mean NO_2 concentrations at each modelled receptor for the existing baseline (2019) scenario have been calculated from the modelled road-NO_x concentrations using the 'NOx to NO_2' calculator provided on the Defra LAQM website (version 7.1, dated April 2019). The calculator requires the input of background NO_2 concentrations which were obtained from Defra background concentrations for each relevant grid square.

3.5.4 Contributions to annual mean NO_x and PM_{10} concentrations from road sources were not removed from the background concentrations as not all road sources within each grid square have been specifically modelled in the assessment.

3.5.5 Total annual mean PM_{10} concentrations are calculated by summing the predicted road source PM_{10} contributions and the predicted background PM_{10} concentrations for 2019 for the grid square in which the receptors are located. Full results are presented in Appendix 6.3.

3.5.6 Predicting short-term NO_2 concentrations (averaging period of 1-hour) is difficult as these are highly variable. Research has identified that exceedances of the NO_2 1-hour mean AQAL are unlikely to occur where the annual mean is below 60 µg/m^3 and reference is therefore made to the long-term concentrations as exceedances of the long-term AQAL would occur before exceedance of the short-term AQAL[1]. Predicting short-term PM_{10} concentrations (averaging period of 24 hours) can also be challenging. A relationship has been derived between the annual mean PM10 concentration and number of exceedances of the 24-hour mean of 50 µg/m^3, this provides an annual mean PM_{10} concentration of about 31 µg/m^3 as being the concentration at which exceedances of the short-term AQAL may occur[1].

Assessment

3.5.7 Total NO_2 and PM_{10} concentrations at receptor facades have been calculated by the same process for the future baseline (Do Nothing) and with-development (Do Something) scenarios. The results have been used to determine both the predicted changes in pollutant concentrations at receptor facades with the development and the resulting total pollutant concentrations as discussed below in Section 4.

3.5.8 The severity of impacts of the predicted changes in pollutant concentrations at modelled receptors is assessed in accordance with the IAQM guidance. This provides an assessment methodology based on the predicted pollutant changes and resulting total concentration as summarised below:

3.5.9 The IAQM guidance provides a methodology for assessing the severity of impacts at individual receptors, based on the predicted change in concentration of a pollutant due to a development and the resulting total concentration (as a long-term average) as summarised in Table 3.4.

Table 3.4: Impact descriptors for individual receptors

Long term average concentration at a receptor in assessment year	% Change in concentration relative to AQAL[1]				
	0	1	2-5	6-10	>10
75% of less of AQAL	negligible	negligible	negligible	slight	moderate
76-94% of AQAL	negligible	negligible	slight	moderate	moderate
95-102% of AQAL	negligible	slight	moderate	moderate	substantial
103-109% of AQAL	negligible	moderate	moderate	substantial	substantial
110% of more of AQAL	negligible	moderate	substantial	substantial	substantial

Note: Refer to Table 6.3 of IAQM[10] guidance for detail and explanatory notes

1.The change in concentration relative to the AQAL is rounded to the nearest whole number; i.e. where the % change is less than 0.5% the % change is 0%; where between 0.5% and 1% the change is 1%

3.5.10 Once the impact has been described at each specific receptor the overall significance of the air quality impacts is assessed. IAQM guidelines do not provide a traditional matrix of significant effects with regard to air quality. The judgement on the overall significance of air quality effects of the proposals is informed by the predicted impacts at individual receptors and takes into account a number of factors such as, but not limited to:

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

4 Model Results and Assessment

4.1 Existing Baseline (2019)

4.1.1 Full results are provided in Appendix 6.3. No exceedances of the long-term NO_2 AQAL are predicted. The highest predicted concentration is 27.92 µg/m^3 at R28 which represents a residential façade on Kingsland Road, adjacent to the junction between the A55 and London Road.

4.1.2 This is higher than the predicted Defra roadside annual mean NO_2 concentrations for 2018 for this stretch of highway, which predicts roadside concentrations to be in the range 10-20 µg/m^3. The model is therefore potentially over-predicting NO_2 concentrations and is considered to be robust and conservative.

4.1.3 To assess potential exceedances of the short-term NO_2 AQAL reference is made to an annual mean concentration of 60 µg/m^3 in accordance with Defra guidance[1]. Concentrations are not predicted above 60 µg/m^3 at any location, including those additional receptors considered where members of the public may spend 1-hour or more, with the highest predicted concentration at such a receptor being 16.47 µg/m^3 at R32 which represents outdoor seating at a McDonald's restaurant adjacent to the A55.

4.1.4 No exceedances of the long-term PM_{10} AQAL are predicted at any relevant receptor, with the highest concentration predicted at R28 again at 12.03 µg/m^3. As per Defra guidance to assess potential exceedances of the short-term PM_{10} AQAL reference is made to an annual mean concentration of 31 µg/m$^{3.}$ Concentrations are not predicted above 31 µg/m^3 at any location, including those additional receptors considered where members of the public may spend 1-hour or more, with the highest predicted concentration being 9.86 µg/m^3 at R32 which represents a outdoor seating at a McDonald's restaurant adjacent to the A55.

4.1.5 The results are consistent with the expectations based on the existing road network and junctions. The model set-up is therefore considered appropriate to the assessment.

4.2 Detailed Assessment – NO_2 Results

4.2.1 The maximum predicted modelled increase in post-development annual mean NO_2 concentrations at receptors are assessed in accordance with the IAQM guidance and summarised below. Full details are provided in Appendix 6.3.

Table 4.1: Summary of Maximum Modelled Increases in NO_2 - 2024

Receptor	Maximum Change in Annual Mean Concentration		Predicted Façade Concentration (µg/m^3)[2]	Impact
	µg/m^3	%[1]		
Sensitive use				
R19	1.42	4	12.68	negligible
Leisure use				
R14	1.01	3	8.51	negligible

1: maximum change in annual mean concentration as % of assessment level; rounded in accordance with IAQM guidance
2: maximum NO_2 concentration based on predicted background concentrations for grid squares in which receptors are located for the modelled years
3: Defra's 'NOx to NO2 calculator' (v7.1) used; all non-urban UK traffic

Table 4.2: Summary of Maximum Modelled Increases in NO_2 - 2030

Receptor	Maximum Change in Annual Mean Concentration		Predicted Façade Concentration (µg/m³)[2]	Impact
	µg/m³	%[1]		
Sensitive use				
R19	0.87	2	9.26	negligible
Leisure use				
R14	0.62	2	6.60	negligible

1: maximum change in annual mean concentration as % of assessment level; rounded in accordance with IAQM guidance
2: maximum NO_2 concentration based on predicted background concentrations for grid squares in which receptors are located for the modelled years
3: Defra's 'NOx to NO2 calculator' (v7.1) used; all non-urban UK traffic

4.2.2 Potential changes in NO_2 concentrations of 1% or more relative to the AQAL are predicted at a number of modelled sensitive and residential use receptors in 2024. The maximum predicted change is 1.42 µg/m³, 4% of the AQAL, predicted at a receptor (R19) close to the junction of Boston Street and Victoria Road. The resulting total annual mean NO_2 concentration is, at 12.68 µg/m³, well below the AQAL with a resulting severity of impact of *negligible*.

4.2.3 The maximum changes do not necessarily occur where NO_2 concentrations are predicted to be highest. The highest NO_2 concentration at a sensitive use is predicted at 16.78 µg/m³ at R28, a residential property adjacent to the junction between Victoria Road, the A55 and London Road. This well below the AQAL. The predicted change at this receptor is 1% with a resulting severity of impacts of *negligible*.

4.2.4 Predicted resulting annual mean concentrations at receptors where the short-term AQAL may be relevant are all well below 60 µg/m³, with the highest concentration being predicted at R28 at 16.78 µg/m³. No exceedances of the short-term AQAL are therefore predicted at any location.

4.2.5 Predicted changes in concentrations at relevant receptors are less for 2030 with the maximum predicted change at sensitive use receptors being 0.87 ug/m³ (2% of the AQAL) at receptor R19 close to the junction of Boston Street and Victoria Road. The resulting total annual mean NO_2 concentration is, at 9.26 µg/m³, well below the AQA with a resulting severity of impact of *negligible*.

4.2.6 Resulting total concentrations at receptor facades are reduced in 2030, as expected due to decreasing vehicle exhaust emissions, with the maximum total facade concentration at ground floor residential use being 12.04 µg/m³ at R28, well below the AQAL. As for 2024 no exceedances of the short-term AQAL are predicted at any relevant receptor.

4.3 Detailed Assessment – PM_{10} Results

4.3.1 Potential changes in PM_{10} concentrations of 1% relative to the AQAL are predicted at a number of modelled sensitive and residential use receptors along Prince of Wales Road and Victoria Road.

4.3.2 The maximum predicted change at a residential receptor is 0.36 µg/m^3, 1% of the AQAL, predicted at a receptor (R19) close to the junction of Boston Street and Victoria Road in 2024. The resulting total annual mean NO_2 concentration is, at 10.79 µg/m^3, well below the AQA with a resulting severity of impacts of *negligible*. The maximum predicted change at a leisure receptor is 0.25 µg/m^3, 1% of the AQAL, at receptor R14 representing allotments adjacent to Prince of Wales Road.

4.3.3 Potential changes in PM_{10} concentrations at all modelled receptor facades are slightly reduced in 2030. The maximum predicted change in concentrations is still predicted at receptor R19, at 0.35 µg/m^3, 1% of the AQAL, with a resulting *negligible* severity of impacts irrespective of background concentrations.

4.3.4 Predicted resulting annual mean concentrations of PM_{10} at short-term receptors are all well below 31 µg/m^3, with the highest concentration being predicted at R32 at 9.65 µg/m^3 in 2024. No exceedances of the short-term AQAL are therefore predicted at any location.

4.4 Assumptions and Limitations

4.4.1 Predicted traffic data has been provided by Axis; for full details reference should be made to the Transport Assessment. Traffic speeds used in the model are based on field observations and local speed limits.

4.4.2 The vehicle emissions assessment has been undertaken using predicted air quality data, vehicle emissions factors and the 'NO_x to NO_2' calculator published by Defra in 2019 and is therefore considered to be robust.

4.4.3 The model has been run using meteorological data from Valley, which provides the closest available data. This is considered appropriate for the Site although it should be noted local variation in weather and wind conditions are likely to exist.

4.4.4 The traffic data does not include data for the Port highway that parallels Victoria Road. However, these flows will be incorporated within the Defra predicted background NO_x concentrations used on the assessment. The resulting total NO_2 concentrations are consistent with expectations and the model is considered robust and conservative.

4.4.5 The modelled road-contributions of NO_x and PM_{10} are considered to be consistent with expectations given the road network, baseline traffic flows and predicted additional traffic flows with the development.

4.4.6 The predicted 2024 and 2030 total façade pollutant concentrations were calculated from the modelled road contributions using the Defra predicted background concentrations for the relevant assessment year for the grid squares in which each receptor is located.

4.4.7 The above assessment is conservative as it assumes completion of the development by 2024. In reality development is expected to take several years; potential impacts in 2024 will therefore be reduced to those described as only partial development would have occurred by that date.