

APPENDIX 14.1

Appendix 14.1: Air Quality Assessment Detailed Methodology

- 1.1 This appendix presents the technical information and data upon which the air quality assessment is based.

Construction Phase Dust Assessment

- 1.2 Table A1 provides examples of the potential dust emissions classes for each of the construction activities, as provided in the IAQM guidance on the assessment of construction dust. It should be noted that not all the criteria need to be met for a particular class. Once the class has been determined the risk category can be determined from the matrices presented in Tables 14.3 to 14.6 in Chapter 14: Air Quality.

Table A1: Criteria for the Potential Dust Emissions Class

Activity	Class	Example Criteria
Demolition	Large	Total Building volume >50,000m ³ , potentially dusty construction material (e.g. concrete), on site crushing and screening, demolition activities >20m above ground level.
	Medium	Total Building volume 20,000-50,000m ³ , potentially dusty construction material, demolition activities 10-20m above ground level.
	Small	Total Building volume <20,000m ³ , construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.
Earthworks	Large	Total site area >10,000m ² , potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved >100,000 tonnes.
	Medium	Total site area <2,500m ² , soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <10,000 tonnes, earthworks during wetter months.
	Small	Total site area <2,500m ² , soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <10,000 tonnes, earthworks during wetter months.
Construction	Large	Total Building volume >100,000m ³ , piling, on site concrete batching, sand blasting.
	Medium	Total building volume 25,000 m ³ - 100,000m ³ , potentially dusty construction material (e.g. concrete), piling, on site concrete batching.
	Small	Total building volume <25,000m ³ , construction material with low potential for dust release (e.g. metal cladding or timber).
Trackout	Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m.
	Medium	10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material, unpaved road length 50-100m.
	Small	<10 HDV (>3.5t) outward movements in any one day, surface material low potential for dust release, unpaved road length <50m.

- 1.3 Once the risk category has been defined, the significance of the likely dust impacts can be determined, taking into account the factors that define the sensitivity of the surrounding area.

Examples of the factors defining the sensitivity of the area as set out in the IAQM guidance are presented in Table A2.

Table A2: Examples of Factors Defining Sensitivity of the Area

Type of Effect	Sensitivity of Receptor	Examples
Sensitivities of People to Dust Soiling Effects	High	Users can reasonably expect a enjoyment of a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected ¹ to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks ² and car showrooms.
	Medium	Users would expect ¹ to enjoy a reasonable level of amenity, but would not reasonably expect ¹ to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected ¹ to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Indicative examples include parks and places of work.
	Low	The enjoyment of amenity would not reasonably be expected ¹ ; or property would not reasonably be expected ¹ to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks ² and roads.
Sensitivities of People to Health Effects of PM ₁₀	High	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM ₁₀ (in the case of the 24-hour objectives, relevant location would be one where individuals may be exposed for eight hours or more in a day). ³ Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.
	Medium	Locations where the people exposed are workers ⁴ , and exposure is over a time period relevant to the air quality objective for PM ₁₀ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include office and shop workers, but will generally not include workers occupationally exposed to PM ₁₀ , as protection is covered by Health and Safety at Work legislation.
	Low	Locations where human exposure is transient. ⁵ Indicative examples include public footpaths, playing fields, parks and shopping streets.
Sensitivities of Receptors to Ecological Effects	High	Locations with an international or national designation and the designated features may be affected by dust soiling; or Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain ⁶ Indicative examples include a Special Area of Conservation (SAC)

	designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
Medium	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or Locations with a national designation where the features may be affected by dust deposition. Indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.
Low	Locations with a local designation where the features may be affected by dust deposition. Indicative example is a local Nature Reserve with dust sensitive features.
1	People's expectations will vary depending on the existing dust deposition in the area.
2	Car parks can have a range of sensitivities depending on the duration and frequency that people would be expected to park their cars there, and the level of amenity they could reasonably expect whilst doing so. Car parks associated with work place or residential parking might have a high level of sensitivity compared to car parks used less frequently and for shorter durations, such as those associated with shopping. Cases should be examined on their own merits.
3	This follows Defra guidance as set out in LAQM.TG(09).
4	Notwithstanding the fact that the air quality objectives and limit values do not apply to people in the workplace, such people can be affected to exposure of PM10. However, they are considered to be less sensitive than the general public as a whole because those most sensitive to the effects of air pollution, such as young children are not normally workers. For this reason workers have been included in the medium sensitivity category.
5	There are no standards that apply to short-term exposure, e.g. one or two hours, but there is still a risk of health impacts, albeit less certain.
6	Cheffing C. M. & Farrell L. (Editors) (2005), The Vascular Plant. Red Data List for Great Britain, Joint Nature Conservation Committee.

1.4 Table A3, Table A4 and Table A5 show how the sensitivity of the area may be determined for effects related to dust soiling (nuisance), human health and ecosystem respectively. When using these tables it should be noted that distances are to the dust source and so a different area may be affected by the on-site works than by trackout (i.e. along the routes used to access the site). The IAQM guidance advises that the highest level of sensitivity from each table should be recorded.

Table A3: Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A4: Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM10 Concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32µg/m ³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32µg/m ³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28µg/m ³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24µg/m ³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table A5: Sensitivity of the Area to Ecological Impacts

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Operational Development Assessment

ADMS-Roads

- 1.5 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; which requires a range of input data, which can include pollutant emissions rates, meteorological data and local topographical information.
- 1.6 The potential effects of the Development on local air quality was assessed using the advanced atmospheric dispersion model ADMS-Roads, taking into account the contribution of emissions from forecast road-traffic on the local road network by the completion year (taken to be 2023).
- 1.7 The ADMS-Roads model is a comprehensive tool for investigating air pollution in relation to road networks. On review of the Site, and its surroundings, ADMS-Roads was considered appropriate for the assessment of the potential long and short term effects of the Development

on air quality. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations. It can predict long-term and short-term concentrations, including percentile concentrations. The use of the ADMS-Roads model was agreed with the Environmental Health Officer at Newport City Council (NCC) (see correspondence at the end of this appendix).

- 1.8 ADMS-Roads model is a formally validated model, developed in the United Kingdom (UK) by CERC (Cambridge Environmental Research Consultants). This includes comparisons with data from the UK's air quality Automatic Urban and Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation and their models were compared favourably against other E.U and U.S. EPA systems. Further information in relation to this is available from the CERC website at www.cerc.co.uk.

Model Scenarios

- 1.9 To assess the potential effects of the Development on local air quality, future 'without Development' and 'with Development' scenarios were assessed. The Development is anticipated to be complete in 2023 and therefore this is the year in which these future scenarios were modelled.
- 1.10 The year 2016 was also modelled to establish the existing baseline situation because it is the latest full year of existing monitoring data from NCC surrounding the Site against which the air quality model is verified (discussed further below). Base year traffic data for 2016 and meteorological data for 2016 were also used to be consistent with the verification year.
- 1.11 Taking into account recent analyses by Defra¹ showing that historical NO_x and NO₂ concentrations are not declining in line with emission forecasts, as outlined in the Air Quality Assessment, a sensitivity analysis was undertaken on the basis of no future reductions in NO_x/NO₂ concentrations (i.e. considering the potential effects of the Development against the current baseline 2016 conditions by applying the 2023 road traffic data to 2016 background concentrations and road traffic emission rates). The results for this sensitivity analysis are presented further below.

Traffic Data

- 1.12 Traffic flow data comprising Annual Average Daily Traffic (AADT) flows, traffic composition (% Heavy-Duty Vehicles (HDVs)) were used in the model as provided by the project transport consultants (Asbri Transport) for the surrounding road network, inclusive of traffic flows for committed developments near the Site. Table A6 presents the traffic data used within the Air Quality Assessment.
- 1.13 The methodology for calculating the expected change in vehicle trips as a result of the Development, once completed and operational, is set out in detail within the Transport Assessment (submitted separately with the planning application). The assessment covers all traffic generated by the Development, including servicing and delivery trips. For the future year flows, local traffic growth factors were applied to take into account traffic growth in the area.

1 <http://laqm.defra.gov.uk/faqs/faqs.html>: Measured nitrogen oxides (NO_x) and/or nitrogen dioxide (NO₂) concentrations in my local authority area do not appear to be declining in line with national forecasts.

Table A6: 24 hour AADT Data Used within the Assessment

Link Name	Speed (kph)	Base 2016		Without 2023		With 2023	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
Caerleon Road (North)	32	8331	2.61	9054	2.61	9471	2.49
Caerleon Road (South)	32	8860	2.53	9629	2.53	10222	2.38
Turner Street	32	3611	0.66	3924	0.65	4857	0.52
Trostrey Street	32	264	6.25	287	6.25	287	6.25
Clarence Place	32	16592	2.87	18032	2.87	18624	2.78
East Usk Road	32	911	2.07	990	2.07	990	2.07
Church Road	32	6996	2.39	7602	2.39	8195	2.22
Chepstow Road	32	8218	3.04	8931	3.04	8931	3.04
Corporation Road	32	1704	2.91	1852	2.91	1852	2.91
Turner St (West)	32	1331	1.42	1447	1.42	2515	0.82

Vehicle Speeds

- 1.14 To take into account the presence of slow moving traffic along the links in the area, the speed at the junctions were reduced using the following criteria recommended within LAQM.TG(16)²:
- Traffic on the carriageway approaching the lights when red, e.g. 5-20 kph, depending on the time of day and level of congestion at the junction;
 - Traffic approaching the lights when green, e.g. 20-50 kph; and
 - Traffic on the carriageway approaching the lights when red, e.g. 5-20 kph, depending on the time of day and how congested the junction is.
- 1.15 LAQM.TG(16) considers that the combined effect of these three conditions is likely in most instances to be a two-way average speed for all vehicles of 20 to 40kph at junctions and that speeds in similar ranges would also apply at roundabouts. For this assessment speeds at busy junctions was reduced to 20kph to account for slow moving traffic.

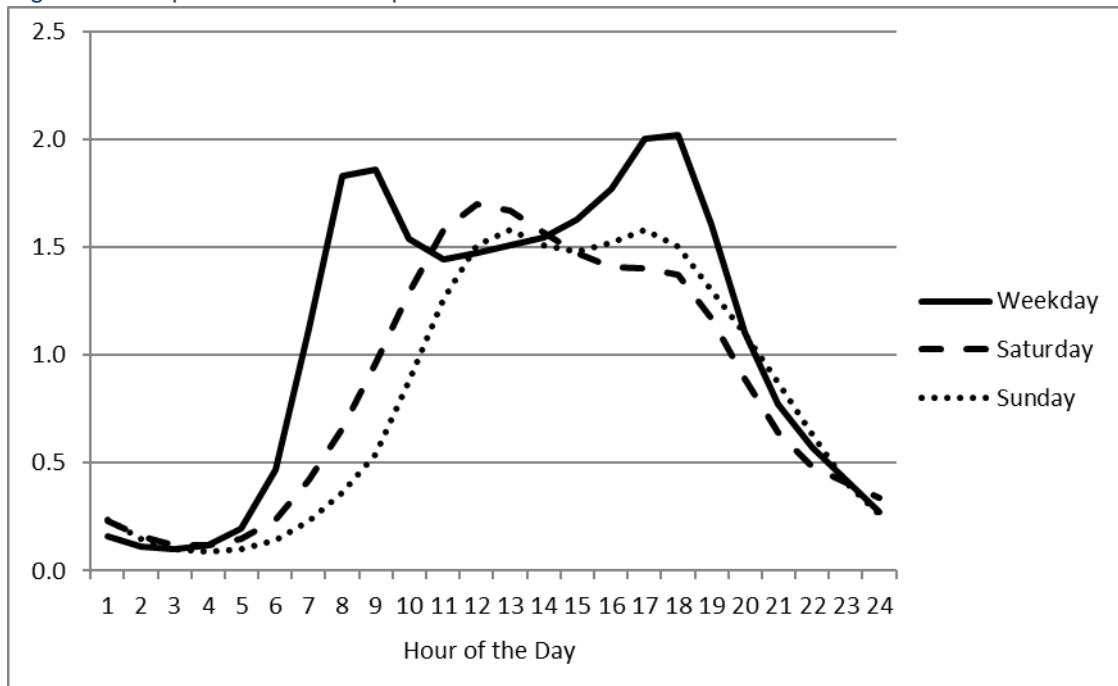
Diurnal Profile

- 1.16 The ADMS-Roads model uses an hourly traffic flow based on the daily (AADT) flows. Traffic flows follow a diurnal variation throughout the day and week. Therefore, a diurnal profile was used in the model to replicate how the average hourly traffic flow would vary throughout the day and the week. This was based on data (the latest available at the time of the assessment) collated by Waterman from the Department for Transport (DfT) statistics Table TRA0307: 'Traffic Distribution by Time of Day on all roads in Great Britain', 2016³, which is the latest data available at the time of undertaking the air quality assessment. **Figure A1** presents the diurnal variation in traffic flows which has been used within the model.

² Defra, 2016, London Local Air Quality Management Technical Guidance LAQM.TG (16)

³ Department for Transport (DfT) Statistics, www.dft.gov.uk/statistics/series/traffic

Figure A1: Department for Transport Diurnal Traffic Variation



Street Canyon Effect

- 1.17 Narrow streets with tall buildings on either side have the potential to create a confined space, which can interfere with the dispersion of traffic pollutants and may result in pollutant emissions accumulating in these streets. In an air quality model, these narrow streets are described as street canyons.
- 1.18 ADMS-Roads includes a street canyon model to take account of the additional turbulent flow patterns occurring inside such a narrow street with relatively tall buildings on both sides. LAQM.TG(16) identifies a street canyon “as narrow streets where the height of buildings on both sides of the road is greater than the road width.”
- 1.19 Following a review of the road network to be included within the model, it was considered that modelled roads are relatively wide and the existing buildings along these roads are not considered to be tall. The Development would not cause any street canyons to be created. Therefore, no street canyons were included within the model for any of the scenarios considered.

Road Traffic Emission Factors

- 1.20 The latest version of the ADMS-Roads model (version 4.0.1) was used for the assessment. The model includes the latest vehicle emission factors published by Defra in the Emission Factors Toolkit (EFT) (version 7.0, published in July 2016). Version seven of the EFT is based on the COPERT 4v11 database published by the European Environment Agency and includes updates from the National Atmospheric Emissions Inventory (NAEI) and the London Atmospheric Emissions Inventory (LAEI) and takes into account updated fleet composition data and projections in London.
- 1.21 The EFT uses several parameters (traffic flow, percentage of HDV, speed and road type) to calculate road traffic emissions for the selected pollutants.

Background Pollutant Concentrations

- 1.22 Background pollutant concentration data (i.e. concentrations due to the contribution of pollution sources not directly taken into account in the dispersion modelling) have been added to contributions from the modelled pollution sources, for each year of assessment.
- 1.23 Urban background pollution monitoring is undertaken by NCC at one automatic monitor located at St Julian's School (332418, 189603) approximately 0.7km north of the Site. **Table A7** shows the most recent concentrations measured at the St Julian's School monitor.

Table A7: Measured Concentrations at the St Julian's Urban Background Monitor ($\mu\text{g}/\text{m}^3$)

Pollutant	Averaging Period	AQS Objective	2014	2015	2016
NO ₂	Annual Mean ($\mu\text{g}/\text{m}^3$)	40 $\mu\text{g}/\text{m}^3$	22.4	21.0	22.0
	1-Hour Mean (No. of Hours)	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1	0	0
PM ₁₀	Annual Mean ($\mu\text{g}/\text{m}^3$)	40 $\mu\text{g}/\text{m}^3$	16	-	16
	24-Hour Mean (No. of Days)	50 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 35 times a year	3	3	1
PM _{2.5}	Annual Mean ($\mu\text{g}/\text{m}^3$)	25 $\mu\text{g}/\text{m}^3$	12	10	10

Notes: 2014 and 2015 Data obtained from NCC Air Quality Annual Progress Report for 2016
2016 Data obtained from www.welshairquality.co.uk

- 1.24 **Table A7** indicates that the NO₂, PM₁₀ and PM_{2.5} objectives were met in all years at the St Julian's School urban background monitor. NCC also undertakes background air quality monitoring of NO₂ at three diffusion tubes co-located with the St Julian's School automatic monitor.
- 1.25 In addition to the background monitoring undertaken by NCC, background concentrations of NO_x, NO₂, PM₁₀ and PM_{2.5} are available from the Defra Local Air Quality Management website⁴ for 1x1km grid squares, for years 2013 to 2030. **Table A8** presents the Defra mapped NO₂ background concentrations for the grid square the Site is located within (332500, 18950 and 331500, 188500) for 2016 and 2023.

Table A8: Defra background maps in 2016 and 2023 for the grid squares at the site

Pollutant	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)			
	2016		2023	
	332500, 189500	331500, 188500	332500, 189500	331500, 188500
NO _x	32.8	36.0	22.6	26.5
NO ₂	22.1	23.7	16.0	18.2
PM ₁₀	17.1	15.9	16.3	15.1
PM _{2.5}	11.9	11.3	11.1	10.6

- 1.26 **Tables A7** and **A8** show that the 2016 monitored urban background NO₂ concentration of 22.0 $\mu\text{g}/\text{m}^3$ at NCC's St Julian's School is similar to the Defra background maps for the grid squares at the Site (22.1 and 23.7 $\mu\text{g}/\text{m}^3$). As the Defra background maps show a higher concentration, it has been used, as a conservative assumption.
- 1.27 Background concentrations of PM₁₀ and PM_{2.5} have also been obtained from the Defra background maps as they are slightly higher than those measured at the St Julian's School

⁴ <http://uk-air.defra.gov.uk/>

monitoring location. The background concentrations used in the assessment are shown in Table A10 presents the background concentrations used within the air quality assessment.

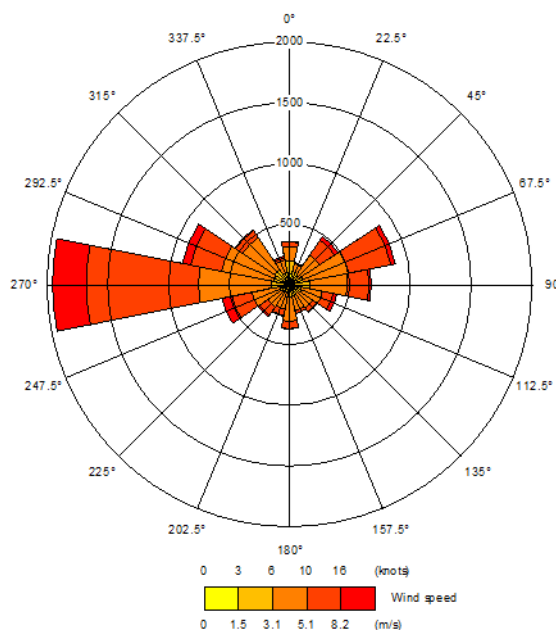
Table A9: Background concentrations used in the assessment ($\mu\text{g}/\text{m}^3$)

Pollutant	2016	2023
Grid Square 332500, 189500; Verification DT 28 and 11, Receptors 1-2		
NO _x	32.8	22.6
NO ₂	22.1	16.0
PM ₁₀	17.1	16.3
PM _{2.5}	11.9	11.1
Grid Square 331500, 188500; Verification DT 68, 67, 50, 24 & 1, Receptors 3-18		
NO _x	36.0	26.5
NO ₂	23.7	18.2
PM ₁₀	15.9	15.1
PM _{2.5}	11.3	10.6

Meteorological Data

- 1.28 Local meteorological conditions strongly influence the dispersal of pollutants. Key meteorological data for dispersion modelling include hourly sequential data including wind direction, wind speed, temperature, precipitation and the extent of cloud cover for each hour of a given year. As a minimum ADMS-Roads requires wind speed, wind direction, and cloud cover.
- 1.29 Meteorological data to input into the model were obtained from the Rhoose (Cardiff) Meteorological Station, which is the closest to the Site and considered to be the most representative. The 2016 data were used to be consistent with the base traffic year and model verification year. It was also used for the 2023 scenario for the air quality assessment. **Figure A2** presents the wind-rose for the meteorological data.

Figure A2: 2016 Wind Rose for the Rhoose (Cardiff) Meteorological Site



- 1.30 Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75 m/s. It is recommended in LAQM.TG(16) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(16) recommends that meteorological data should only be used if the percentage of usable hours is greater than 85%. 2016 meteorological data from Rhoose (Cardiff) includes 8,733 lines of usable hourly data out of the total 8,784 for the year, i.e. 99.4% of usable data. This is above the 85% threshold, and is therefore adequate for the dispersion modelling.
- 1.31 A value of 0.2 was used for the Rhoose (Cardiff) Meteorological Station, which is representative of agricultural areas and is considered appropriate following a review of the local area surrounding the Meteorological Station.

Model Data Processing

- 1.32 The modelling results were processed to calculate the averaging periods required for comparison with the Air Quality Strategy Objectives.
- 1.33 NO_x emissions from combustion sources (including vehicle exhausts) comprise principally nitric oxide (NO) and NO₂. The emitted NO reacts with oxidants in the air (mainly ozone) to form more NO₂. Since only NO₂ is associated with impacts on human health, the air quality standards for the protection of human health are based on NO₂ and not total NO_x or NO.
- 1.34 The ADMS-Roads model was run without the Chemistry Reaction option to allow verification (see below). Therefore, a suitable NO_x:NO₂ conversion was applied to the modelled NO_x concentrations. There are a variety of different approaches to dealing with NO_x:NO₂ relationships, a number of which are widely recognised as being acceptable. However, the current approach was developed for roadside sites, and is detailed within the Technical Guidance LAQM.TG(16).
- 1.35 The LAQM Support website provides a spreadsheet calculator⁵ to allow the calculation of NO₂ from NO_x concentrations, accounting for the difference between primary emissions of NO_x and background NO_x, the concentration of O₃, and the different proportions of primary NO₂ emissions, in different years. This approach is only applicable to annual mean concentrations.
- 1.36 Research⁶ undertaken in support of LAQM.TG(16) has indicated that the hourly mean limit value and objective for NO₂ is unlikely to be exceeded at a roadside location where the annual-mean NO₂ concentration is less than 60µg/m³. The hourly objective is, therefore, not considered further within this assessment where the annual-mean NO₂ concentration is predicted to be less than 60µg/m³.
- 1.37 To calculate the number of daily exceedances of 50µg/m³ PM₁₀, the relationship between the number of 24-hour exceedances of 50µg/m³ and the annual mean PM₁₀ concentration from LAQM.TG (16) was applied as follows:

$$\text{Number of Exceedances} = -18.5 + 0.00145 \times \text{annual mean}^3 + (206/\text{annual mean})$$

⁵ AEA, NO_x to NO₂ Calculator, <http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php> Version 4.1, 19 June 2014

⁶ Defra (2016), 'Local Air Quality Management Policy guidance PG(16)', DEFRA, London

Other Model Parameters

- 1.38 There are other parameters that are used within the ADMS-Roads model, which are described for completeness and transparency:
- The model requires a surface roughness value to be inputted.
 - A value of 0.5 was used for the Site, which is representative of open suburbia; and
 - A value of 0.2 was used for the Rhoose (Cardiff) Meteorological Station, which is representative of agricultural areas;
 - The model requires the Monin-Obukhov length (a measure of the stability of the atmosphere) to be inputted. A value of 30m (representative of large towns) was used for the modelling; and
 - The model requires the Road Type to be inputted. '*Wales [Urban]*' was selected and used for the modelling of the road links.

Model Verification

- 1.39 Model verification is the process of comparing monitored and modelled pollutant concentrations for the same year, at the same locations, and adjusting modelled concentrations if necessary to be consistent with monitoring data. This increases the robustness of modelling results.
- 1.40 Discrepancies between modelled and measured concentrations can arise for several reasons, for example:
- Traffic data uncertainties;
 - Background concentration estimates;
 - Meteorological data uncertainties;
 - Sources not explicitly included within the model (e.g. car parks and bus stops);
 - Overall model limitations (e.g. treatment of roughness and meteorological data, treatment of speeds); and
 - Uncertainty in monitoring data, particularly diffusion tubes.
- 1.41 Verification is the process by which uncertainties such as those described above are investigated and minimised. Disparities between modelling and monitoring results are likely to arise as result of a combination of these aspects.

Nitrogen Dioxide

- 1.42 The dispersion model was run to predict annual mean NO_x concentrations at the seven closest NCC diffusion tubes to the Site. The monitoring locations are roadside and considered appropriate for the model verification.
- 1.43 Box 7.15 in LAQM.TG(16) indicates a method based on comparison of the road NO_x contributions and calculating an adjustment factor. This requires the roadside NO_x contribution to be calculated. In addition, monitored NO_x concentrations are required, which were calculated from the annual mean NO₂ concentration at the diffusion tube site using the NO_x to NO₂ spreadsheet calculator as described above. The steps involved in the adjustment process are presented in **Table A11**. The background data for 2016, as presented in **Table A10** were used.
- 1.44 Initially the model was run using 48kph along all links and 32kph at all junctions considered within the model domain. However, when using these inputs, it was found that the model

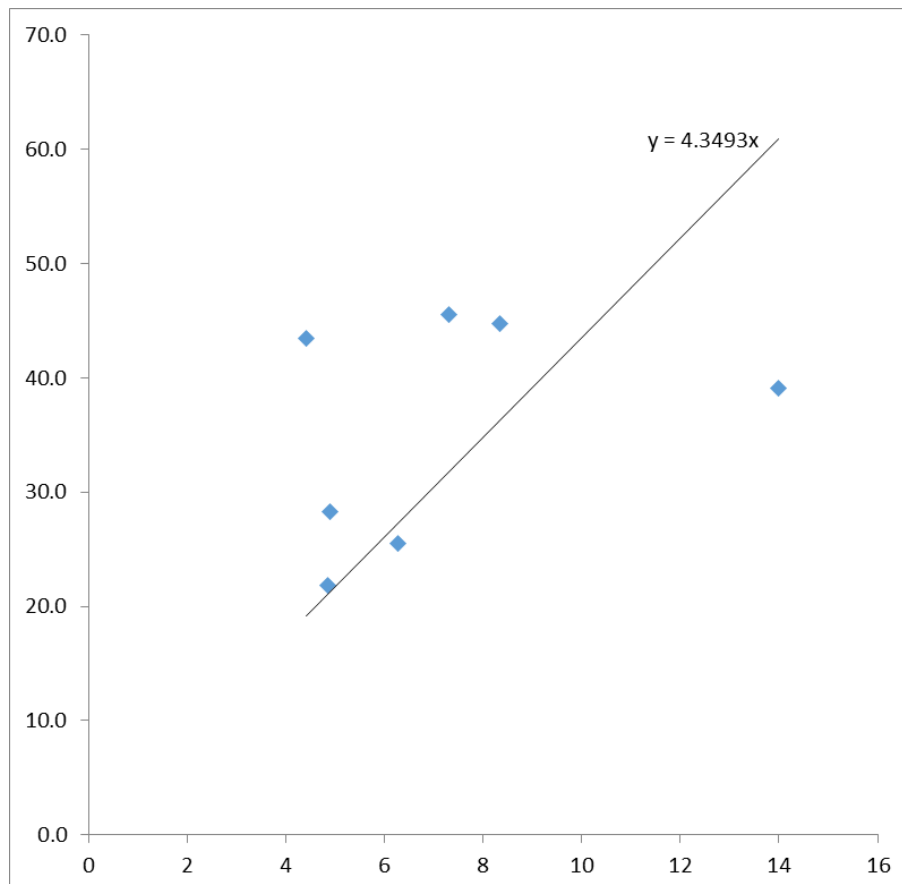
resulted in a large adjustment factor and the model performance was considered as being poor. The model was refined using 32kph along all links and 20kph at all junctions included within the model domain. The results of the model verification are presented below.

Table A10: Model Verification Result for Adjustment NO_x Emissions (µg/m³)

Site ID	Monitored NO ₂	Monitored Road NO _x	Modelled Road NO _x	Ratio of Monitored Road Contribution NO _x /Modelled Road Contribution NO _x
68	42.0	39.1	14.0	2.8
67	34.3	21.8	4.9	4.5
50	44.7	45.5	7.3	6.2
24	44.4	44.8	8.3	5.4
1	36.0	25.5	6.3	4.1
28	42.4	43.5	4.4	9.8
11	35.8	28.3	4.9	5.8

1.45 Figure A1.4 shows the mathematical relationship between modelled and monitored roadside NO_x (i.e. total NO_x minus background NO_x) in a scatter graph (data taken from Table A1.10), with a trendline passing through zero and its derived equation.

Figure A3: Unadjusted Modelled versus Monitored Annual Mean Roadside NO_x at the Monitoring Sites (µg/m³)



- 1.46 Consequently, in **Table A12** the adjustment factor (4.3493) obtained from Figure A3 is applied to the modelled NO_x Roadside concentrations to obtain improved agreement between monitored and modelled annual mean NO_x. This has been converted to annual mean NO₂ using the NO_x:NO₂ spreadsheet calculator.

Table A11: Comparison of Adjusted Road NO_x Emissions (µg/m³)

Site ID	Adjusted Modelled Road NO _x	Modelled Total NO ₂	Monitored Annual Mean NO ₂ (µg/m ³)	% Difference (modelled – monitored)
68	60.9	50.9	42.0	21.2
67	21.1	34.0	34.3	-0.9
50	31.8	38.8	44.7	-13.2
24	36.3	40.8	44.4	-8.1
1	27.3	36.8	36.0	2.2
28	19.2	31.6	42.4	-25.5
11	21.3	32.6	35.8	-9.0

- 1.47 The data in Table A12 indicate that the adjusted model is under predicting at five diffusion tube locations and over predicting at the other two diffusion tube locations. LAQM.TG(16) states where the modelled results are both within 25% of the monitored concentrations that the model verification is appropriate.
- 1.48 The NO_x adjustment process was subsequently applied to all roadside NO_x modelling for 2016 and 2023 scenarios, at the specific receptors locations assessed, before the predicted concentrations were converted to NO₂.

Particulate Matter (PM₁₀ and PM_{2.5})

- 1.49 PM₁₀ and PM_{2.5} monitoring data is not available for the Site area. Therefore, the roadside modelled NO_x adjustment factor of 4.3493 was subsequently applied to all the roadside PM₁₀ and PM_{2.5} modelling results, before adding on the background concentrations for the study area for 2016 and each of the 2023 scenarios, at the specific receptors locations assessed, and before the number of daily exceedences was calculated.

Verification Summary

- 1.50 Any atmospheric dispersion model study will always have a degree of inaccuracy due to a variety of factors. These include uncertainties in traffic emissions data, the differences between available meteorological data and the specific microclimate at each receptor location, and simplifications made in the model algorithms that describe the atmospheric dispersion and chemical processes. There will also be uncertainty in the comparison of predicted concentrations with monitored data, given the potential for errors and uncertainty in sampling methodology (technique, location, handling, and analysis) as well as processing of any monitoring data.
- 1.51 Whilst systematic under or over prediction can be taken in to account through the model verification / adjustment process, random errors will inevitably occur and a level of uncertainty will still exist in corrected / adjusted data.
- 1.52 While every effort has been made to reduce the uncertainties within the model and thus reduce the verification factor as much as possible (as described in paragraph 1.43), the model

verification has been unable to be reduced further. Whilst the existing verification is considered appropriate the further uncertainty maybe a result of:

- local microclimate experienced at the monitoring locations which the model cannot replicate;
- limited ability to assess the uncertainty of model inputs, for example, the actual emission rates of vehicles on the local road network (particularly in proximity to the monitors used for the verification) compared to the emission rates used within the model;
- sampling and measurement error associated with the monitoring sites used for the verification. Which could be influenced by the duration of monitoring (over saturated samples), accuracy of written monitoring duration, collection and transportation errors (if the sample cap has been replaced properly) and errors in analysis; and
- whether the model itself completely describes all the necessary atmospheric and built form processes, such as the local microclimate experienced at the monitoring locations.

1.53 Having consideration of the above uncertainty, overall, it was concluded that with the adjustment factors applied to the ADMS-Roads model, it is performing well and modelled results are suitable to determine the potential effects of the Development on local air quality.

Newport City Council Correspondence

From: Peter Mackintosh (Senior Scientific Officer)
[mailto:Peter.Mackintosh@newport.gov.uk]
Sent: 11 May 2017 10:27
To: Chris Brownlie <chris.brownlie@watermangroup.com>
Subject: RE: Land To South Of Glan Usk Primary School, Herbert Road, Newport.

Hi Chris,

Please find attached the data for Chepstow Road/ Clarence Place / Caerleon Road. Please note that the tube results on Caerleon Road are slightly different from the ones I provided previously.

There is also a study carried out for Newport City Council by AECOM which looked at the Chepstow Road AQMA which might be useful. Its available via the following link:
<http://www.newport.gov.uk/en/Transport-Streets/Pollution-and-noise-control/Air-quality-data-reports.aspx>

Kind regards,

Pete

From: Chris Brownlie [mailto:chris.brownlie@watermangroup.com]
Sent: 02 May 2017 11:02
To: Peter Mackintosh (Senior Scientific Officer)
Subject: RE: Land To South Of Glan Usk Primary School, Herbert Road, Newport.

Hi Peter,

Many thanks for the response to my email and for sending through the 2016 diffusion tube data. Are you able to supply the non-distance corrected data for 2016 and also the details of the new diffusion tube locations (distance from the road, height and grid references)?

The comments about the future users of the development and the request to investigate possible mitigation measures is noted. We will include a discussion of the proposed mitigation measures within the air quality assessment.

The transport consultants have confirmed with their counterparts in the highways department that the junctions assessed in 2013 are still sufficient. Therefore we will be supplied data for the following roads/junctions (which will be consistent with those assessed in the 2013 assessment):

- Caerleon Road/Turner Street/Tesco Junction
- Trostrey Street/Turner Street Junction
- Clarence Place/East Usk Road/Church Rd/Chepstow Rd/Corporation Rd Junction
- Turner St Link under rail bridge

I trust that this data covers the areas of concern within Newport, however if there are any other areas that require assessment then please let me know.

Kind regards,
Chris

Chris Brownlie
Principal Consultant
Waterman Infrastructure & Environment Ltd

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P Please consider the environment before printing this e-mail. Thank you!

From: Peter Mackintosh (Senior Scientific Officer)
[\[mailto:Peter.Mackintosh@newport.gov.uk\]](mailto:Peter.Mackintosh@newport.gov.uk)
Sent: 28 April 2017 15:41
To: Chris Brownlie <chris.brownlie@watermangroup.com>
Subject: RE: Land To South Of Glan Usk Primary School, Herbert Road, Newport.

Hi Chris,

Thanks for the email. Last year we expanded our network of diffusion tubes in the local area. The attached gives the provisional bias adjusted and distance corrected results for the relevant tubes in the local area in 2016. As you can see there is a spread of exceedances and near exceedances in the area. As such we are reviewing the size / scale of both the AQMAs.

With regard to the modelling, I would prefer dispersion modelling approach such as ADMS-Roads rather than DMRB for a study such as this.

From what I understand of the proposed development, there are two access points under the railway bridges that leads onto Chepstow Road/Clarence Place and Caerleon Road.

Comments on the air quality impact of these junctions would be useful.

To further justify the application I would recommend the potential traffic draw from the current planning land use is assessed compared to the proposed residential development, preferably quantified (ie number of potential HGVs vs Cars).

Finally a full assessment of all possible mitigation measures should be provided justifying which are suitable for the development (electric vehicle charging points, integration with the cycle network etc).

There is no need to investigate/comment upon the exposure of the future site users. It is highly unlikely the air quality at the site will be polluted above the air quality objectives. My only concern with respect to air quality regards the road traffic impact the development will have on the neighbouring road system.

Kind regards,

Pete

From: Chris Brownlie [<mailto:chris.brownlie@watermangroup.com>]

Sent: 27 April 2017 16:09

To: Peter Mackintosh (Senior Scientific Officer)

Subject: Land To South Of Glan Usk Primary School, Herbert Road, Newport.

Dear Peter,

Waterman have been commissioned to undertake an air quality assessment for the above site and I am therefore writing to agree the scope and methodology for the proposed air quality assessment to accompany the planning application.

I note from the scoping opinion (17/0037) dated 08 February 2017 from Geraint Roberts that the air quality assessment will need to be made of the impact of the development on the AQMAs on Clarence Place / Chepstow Road and Caerleon Road. The air quality assessment will therefore consider the impact on these AQMAs.

We propose to use the Design Manual for Roads and Bridges (DMRB) air quality screening tool to model the existing, future without development and future with development scenarios at sensitive receptors in proximity to the Site and within the roads modelled and within the two AQMAs identified above. The model will also consider the future concentrations users of the Site would be exposed too. This is the same methodology as was undertaken for the air quality assessment undertaken in 2013 for the site.

To take into account the trend that NO_x and NO₂ concentrations are not declining as expected, the results will include an uncertainty section which will assess the future traffic on the basis of no future reductions (i.e. considering the potential effect of the Development against the current baseline conditions and assuming no improvements in vehicle emissions).

To ensure the performance of the model, a comparison between monitored and modelled concentrations (model verification) would be undertaken at the nearest diffusion tube to the



site, located at 155 Caerleon Road (NCC28B) and 169 Caerleon Road (NCC11A) both located 0.5km southeast of the Site. I would be grateful if you could supply the 2016 bias adjusted monitoring data.

We propose to use background concentrations taken from the latest the Defra maps.

I trust that the proposed methodology is acceptable but I welcome your thoughts on the above scope and would appreciate any recommendations.

Kind regards,
Chris

Chris Brownlie
Principal Consultant
Waterman Infrastructure & Environment Ltd

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t +44 20 7928 7888 | **d** +44 330 060 2847 | **m** +44 7469 858 038

P Please consider the environment before printing this e-mail. Thank you!

Assessor Experience

Name: Christopher Brownlie

Years of Experience: 10

Qualifications:

- BSc (Hons)
- MSc
- AIEMA (Associate Member of the Institute of Environmental Management and Assessment)
- MIAQM (Member of the Institute of Air Quality Management)

Chris has over ten years of experience in the assessment of air quality and odour for a variety of environmental impact assessment projects. Chris has knowledge and extensive experience of designing and undertaking ambient air quality monitoring programmes using real time equipment and passive diffusion tubes. This includes devising monitoring programs for dust deposition, typically to monitor levels of dust generated during construction activities in populated areas where there is the potential for nuisance to be caused.

Chris has been responsible for the technical delivery of a wide range of air quality projects for a variety of clients in both the public and private sector. These projects include consideration of emissions from both transportation and industrial sources, through both monitoring and modelling, and therefore he has an in depth understanding of the regulatory requirements for these sources and the published technical guidance for their assessment.