A66 Northern Trans-Pennine Project
TR010062

3.4 Environmental Statement Appendix 5.3 Air Quality Baseline Monitoring

APFP Regulations 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Volume 3

June 2022

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed
Forms and Procedure)
Regulations 2009**

A66 Northern Trans-Pennine Project
Development Consent Order 202x

3.4 ENVIRONMENTAL STATEMENT
APPENDIX 5.3 AIR QUALITY BASELINE MONITORING

Regulation Number:	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010062
Application Document Reference	3.4
Author:	A66 Northern Trans-Pennine Project Team, National Highways

Version	Date	Status of Version
Rev 1	13 June 2022	DCO Application

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5.3 Baseline Monitoring

5.3.1 Local authority monitoring data

5.3.1.1 Baseline air quality monitoring data for the project study area has been taken from local authority nitrogen dioxide (NO_2) diffusion tube sites operated by Eden District Council (EDC) and Richmondshire District Council (RDC), over the past five years (2016-2020), as shown in ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3). Monitoring of PM_{10} is not currently undertaken in the study area.

5.3.1.2 Table 1: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2016-20 gives the site information and annual mean NO_2 concentrations for the monitoring sites located within the Affected Road Network (ARN) that have been used to verify the roads model. The data is shown in ES Figure 5.2: Air Quality Baseline (Application Document 3.3).

5.3.1.3 Local authority data have been used from locations with a data capture rate of 85% or more in 2019. Additional EDC monitoring data are also presented for Castlegate, Penrith; however, these sites were not used for model verification as they are located outside of the ARN. Where data are exceeding the 40µg/m³ Air Quality Objective (AQO), these are highlighted in bold.

5.3.1.4 Concentrations of annual mean NO_2 exceeding the AQO have been recorded in 2017-2019 in the study area, with reductions in 2020. The exceedances were at roadside locations in Castlegate, Penrith.

5.3.1.5 Data from the National Highways continuous automatic air quality monitoring station adjacent to the A1(M) southbound at Leeming has also been used to verify the rural roads model. The data capture rate for this location was 56% in 2019.

Table 1: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2016-20).

Site ID	Site Name	Coordinates (based on OS grid reference, m)		Annual Mean NO_2 Concentration (µg/m³)				
		X	Y	2016	2017	2018	2019	2020
Eden District Council (Eden District Council, 2021)[1]								
EB15*	Glendale	352329	528475	32	32	32	27	21
EB18*	Cherry Cottage	352246	528667	33	35	33	31	23
EB20*	2 Kemplay Road	352207	528827	32	31	32	28	-
V3*	25b King Street	351720	529966	23	27	30	27	21
V5*	Front Victoria Road/Langton Cottage	351713	529941	35	31	31	28	20
C1	Lower Castlegate#	351413	530069	-	-	**48**	**42**	33

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[1] Eden District Council (2021) LAQM ASR 2021

Site ID	Site Name	Coordinates (based on OS grid reference, m)		Annual Mean NO$_2$ Concentration (µg/m^3)				
		X	Y	2016	2017	2018	2019	2020
C30	40 Castlegate#	351333	530016	37	31	30	29	22
GAF04	New Vic#	351363	530046	39	**47**	**49**	**43**	32
GAF05‡	Station Hotel#	351317	529996	**53**	33	30	28	22
Richmondshire District Council (Richmondshire District Council, 2020)[2]								
R6†	Gatherley Moor Farm	419207	506509	24	23	21	20	21
National Highways								
45 A1M Leeming SB_N†	A1(M) southbound at Leeming	429556	488315	-	-	-	18.6	15.6
Notes:								

Data in bold denotes exceedance of the annual mean NO$_2$ objective given in Appendix 5.1 Table 1: AQS objectives and Limit Values for NO$_2$, PM$_{10}$ and PM$_{2.5}$

* 2019 monitoring data used to verify the urban roads model.

Castlegate Penrith monitoring sites not used for model verification as located outside the ARN.

‡ The site coordinates given in the EDC LAQM ASR 2020 have been adjusted to indicate the diffusion tube location on Castlegate, Penrith.

† 2019 monitoring data used to verify the rural roads model.

5.3.2 Scheme specific baseline monitoring

5.3.2.1 Scheme specific baseline diffusion tube monitoring of NO$_2$ and ammonia (NH$_3$) was carried out within the air quality Project study area at both human and ecological receptors between November 2021 and February 2022.

5.3.2.2 Diffusion tubes were deployed in triplicate following the Department of Environment, Food and Rural Affairs' (Defra) Diffusion Tube Calendar[3] at a total of 16 monitoring locations as shown in ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3).

Baseline NO$_2$ Diffusion Tube Monitoring

5.3.2.3 NO$_2$ diffusion tubes were prepared by Staffordshire Highways Laboratory using 20% triethanolamine (TEA) in water.

5.3.2.4 The data from the four-month survey was annualised to 2019, the model base year, using ratified measurements from four Automatic Urban and Rural Network air quality monitoring stations within 50 miles of the study area (Hartlepool St. Abbs Walk, High Muffles, Sunderland Silksworth and York Bootham). An annualisation factor of 0.670 was derived for

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[2] Richmondshire District Council (2020) ASR 2020.
[3] Department for Environment, Food and Rural Affairs (2021) NO$_2$ Diffusion Tube Monitoring Calendar.

sites AQM1 to AQM14. Measurements from AQM15 and AQM16 have not been annualised.

5.3.2.5   It is necessary to bias adjust diffusion tube results as this type of monitoring is not a reference method and therefore generally has lower accuracy. The annualised mean results were then adjusted using a factor of 0.93 derived from Defra's national diffusion tube bias adjustment factors spreadsheet (Department for Environment Food and Rural Affairs, 2021)[4].

5.3.2.6   Table 2: Baseline NO_2 diffusion tube monitoring below gives the raw, unadjusted concentrations together with the annualised, bias adjusted NO_2 concentrations for each location. The annualised, bias adjusted NO_2 concentrations for each location are shown in ES Figure 5.2: Air Quality Baseline (Application Document 3.3).

5.3.2.7   The NO_2 monitoring results were all below the objective. The highest NO_2 concentration was 21.1µg/m^3 at location AQM1 which was situated adjacent to the southbound carriageway of the A1(M) approximately 1km south of Londonderry.

Table 2: Baseline NO_2 diffusion tube monitoring (µg/m^3)

Site ID	Coordinates (based on OS Grid Reference, m)		Unadjusted average concentration (µg/m^3)	Bias adjusted, annualised average concentration (µg/m^3)
	X	Y		
AQM1	430586	487050	33.9	21.1
AQM2	429565	488323	28.3	17.6
AQM3	423128	497927	21.0	13.1
AQM4	422314	499515	13.6	8.4
AQM5	411848	510954	16.3	10.2
AQM6	407007	513525	5.5	3.4
AQM7	404908	514978	5.5	3.4
AQM8	404319	516664	4.1	2.6
AQM9	389660	512355	13.4	8.3
AQM10	384876	514617	6.9	4.3
AQM11	381668	514555	10.8	6.8
AQM12	380401	514464	12.1	7.5
AQM13	360313	527519	8.7	5.4
AQM14	351056	529264	32.3	20.1
AQM15*†	354750	521677	8.4	-
AQM16*†	358218	512375	22.0	-
Notes:				
* Deployed January and February 2022				
† Measurements not annualised as less than 3 months of monitoring data available				

[4] Department for Environment Food and Rural Affairs (2021) Diffusion Tube Bias Adjustment Factors Spreadsheet.

Baseline NH₃ diffusion tube monitoring

5.3.2.8 NH_3 tubes were provided and analysed by Gradko and co-located at 13 of the 16 monitoring locations. Triplicate tubes were deployed at all sites, except AQM15 and AQM16, for four months and for two months at AQM15 and AQM16 due to land access constraints.

5.3.2.9   Table 3: Baseline NH_3 diffusion tube monitoring results ($\mu g/m^3$) below gives the average NH_3 concentration at each monitoring location. Concentrations for each location are shown in Figure 5.2: Air Quality Baseline (Application Document 3.3).

5.3.2.10   The highest NH_3 concentration was $11.1 \mu g/m^3$ at location AQM2 which was co-located with the National Highways continuous automatic air quality monitoring station situated adjacent to the southbound carriageway of the A1(M) approximately 700m north of Londonderry.

Table 3: Baseline NH_3 diffusion tube monitoring results ($\mu g/m^3$)

Site ID	Coordinates (based on OS Grid Reference, m)		Average concentration ($\mu g/m^3$)
	X	Y	
AQM2	429565	488323	11.1
AQM3	423128	497927	2.8
AQM5	411848	510954	3.3
AQM6	407007	513525	1.6
AQM7	404908	514978	1.9
AQM8	404319	516664	1.7
AQM9	389660	512355	1.8
AQM10	384876	514617	1.6
AQM11	381668	514555	2.4
AQM12	380401	514464	2.9
AQM13	360313	527519	6.1
AQM15*	354750	521677	0.8
AQM16*	358218	512375	4.6
Note:			
* Deployed January and February 2022			

5.3.3   Background concentrations

5.3.3.1   Predicted annual mean background pollutant concentrations have been taken from Defra's most recent (2018) 1km x 1km background maps for 2019. The data used in the assessment are given in Table 4: Defra annual mean background pollutant concentrations ($\mu g/m^3$) and reported for the centre of each grid square. Pollutant concentrations for the opening year (2029) are also presented.

Table 4: Defra annual mean background pollutant concentrations ($\mu g/m^3$)

Year	Pollutant	Minimum concentration ($\mu g/m^3$)	Maximum concentration ($\mu g/m^3$)
2019	NO_X	5.3	15.6
	NO_2	4.3	11.9
	PM_{10}	7.4	15.6
	$PM_{2.5}$	5.1	8.4
2029	NO_X	4.0	9.5
	NO_2	3.3	7.4
	PM_{10}	6.8	14.8
	$PM_{2.5}$	4.6	7.8

5.3.3.2   The 'in-grid square' contribution from major road sector emissions, i.e., motorway, trunk 'A' road and primary 'A' roads, have been removed from the background annual mean NO_X concentration estimates, these are given in Table 5: Adjusted annual mean background pollutant concentrations ($\mu g/m^3$).

5.3.3.3 NO_X and NO_2 concentrations have been adjusted using Defra's NO_2 Adjustment for NO_X Sector Tool (v8.1)[5]. This has been undertaken to avoid double counting of road traffic emissions from those road sources included in the dispersion model.

Table 5: Adjusted annual mean background pollutant concentrations ($\mu g/m^3$)

Year	Pollutant	Minimum concentration ($\mu g/m^3$)	Maximum concentration ($\mu g/m^3$)
2019	NO_X	5.1	12.5
	NO_2	4.1	9.6
	PM_{10}	7.4	15.6
	$PM_{2.5}$	5.1	8.4
2029	NO_X	3.8	9.0
	NO_2	3.1	7.0
	PM_{10}	6.8	14.8
	$PM_{2.5}$	4.6	7.8

5.3.3.4   A comparison has been undertaken between the Defra background concentrations and monitored background concentrations from local authority and scheme specific sites. There is limited background monitoring in the study area, with only one site considered appropriate. Most of the monitoring available in the three affected local authorities are roadside locations and so are not representative of background conditions.

5.3.3.5   A comparison of the monitored background data at the single background monitoring sites and the Defra mapped concentrations has

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[5] Department for Environment, Food and Rural Affairs (2020) NO_X to NO_2 Calculator.

been carried out as shown in Table 6: Comparison between Defra modelled and local authority background NO_2 monitoring data (µg/m^3).

5.3.3.6   Whilst only one background site has been reviewed, the monitored background concentrations are well below the annual mean air quality objective for NO_2 and the absolute difference in µg/m^3 between monitored and modelled is small. The Defra predicted background concentrations have been used for the air quality assessment.

Table 6: Comparison between Defra modelled and local authority background NO_2 monitoring data ($\mu g/m^3$)

Site ID	Site Name	Coordinates (based on OS Grid Reference, m)		Local Authority (LA)	LA monitored ($\mu g/m^3$) (2019)	Defra background ($\mu g/m^3$) (2019)	Difference ($\mu g/m^3$)
		X	Y				
R4	White Rose Crescent	418504	501455	Richmondshire District Council	7.4	6.4	1.0