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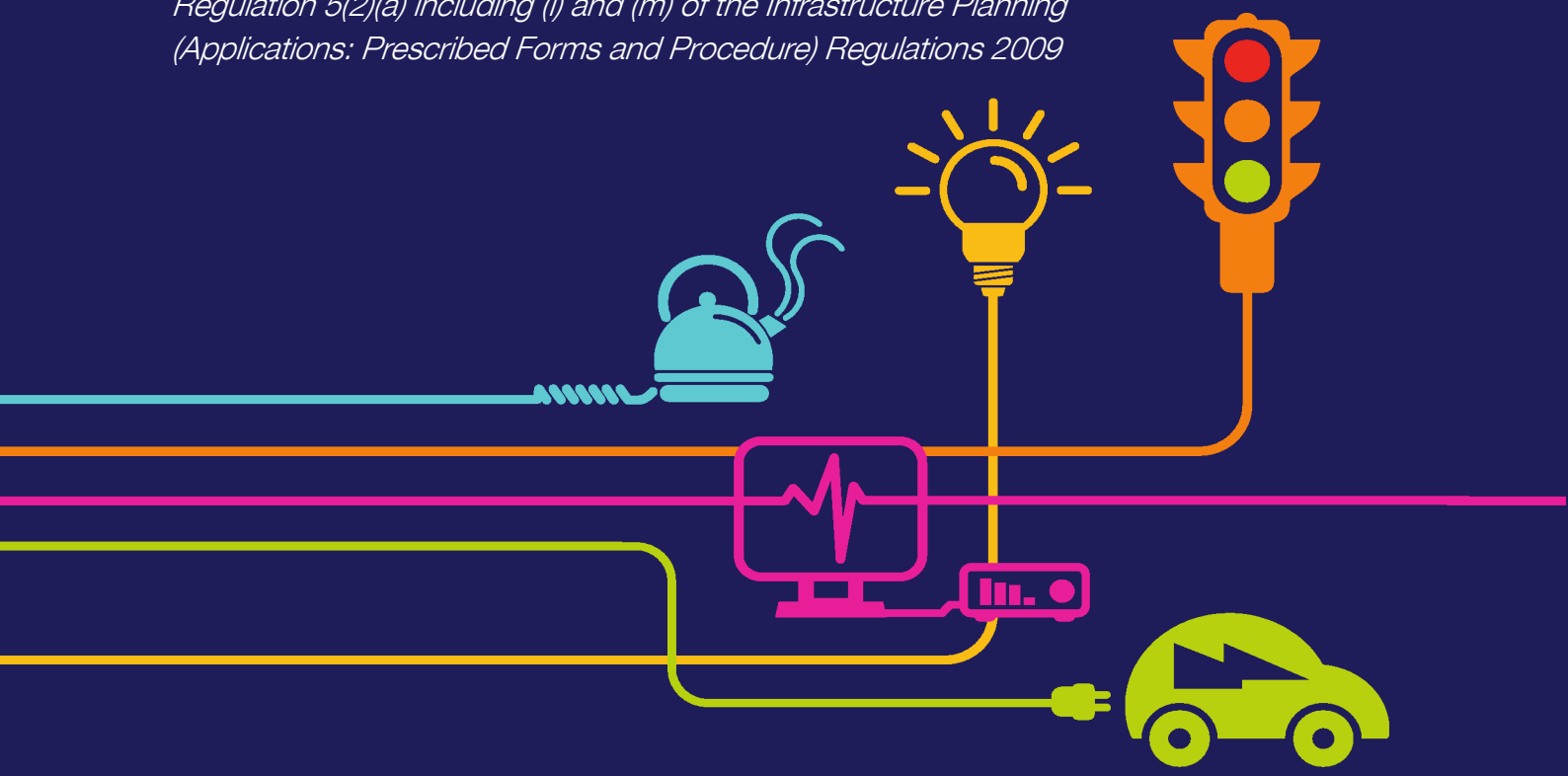
DOCUMENT 5.14.2.3

Detailed Air Quality Monitoring Assessment

Chapter 14 – Appendix 3

National Grid (North Wales Connection Project)

Regulation 5(2)(a) including (l) and (m) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009



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1 Introduction

1.1 OVERVIEW

Road Traffic Emissions Assessment

1.1.1 The traffic data for the Proposed Development demonstrated that during the construction phase, annual average daily traffic (AADT) flows would increase by more than 100 Heavy Goods Vehicles (HGVs) on several road links within the study area, for a period of multiple years during construction. This exceeds the criteria described in current guidance (Ref 14.15) that suggests a detailed assessment of road traffic emissions impacts is required. The links where the criteria would be exceeded are summarised in Table of 14.7 of the Environmental Statement (ES).

1.1.2 The quantification of air quality impacts has been undertaken using the current version of the dispersion modelling software ADMS Roads (v4.1.1.0). ADMS Roads is dispersion modelling software that is commonly used to quantify road traffic emissions contributions to total pollutant concentrations for projects across the UK and overseas.

1.1.3 The scenarios considered within the dispersion modelling exercise for road traffic emissions are:

- Existing baseline situation (representative of 2016) (modelled with 2016 background data, 2016 traffic emission factors and 2016 traffic flows) for use in dispersion model verification against monitoring data that is representative of 2016;
- Peak construction year baseline (representative of 2023) (modelled with 2016 background data, 2016 traffic emission factors and 2023 traffic flows, without the Proposed Development);
- Peak construction year ‘with construction’ scenario (assuming Tunnel Boring Machine (TBM) tunnelling between Braint and Tŷ Fodol) (representative of 2023) (modelled with 2016 background data, 2016 traffic emission factors and 2023 traffic flows with the Proposed Development during construction).
- Peak construction year ‘with construction’ scenario (assuming drill and blast tunnelling between Braint and Tŷ Fodol) (representative of

2023) (modelled with 2016 background data, 2016 traffic emission factors and 2023 traffic flows with the Proposed Development during construction).

- Cumulative peak construction year baseline (representative of 2023) (modelled with 2016 background data, 2016 traffic emission factors and 2023 traffic flows, without the Proposed Development, but with major committed development traffic flows);
- Cumulative peak construction year 'with construction' scenario (assuming TBM tunnelling between Braint to Tŷ Fodol) (representative of 2023) (modelled with 2016 background data, 2016 traffic emission factors and 2023 traffic flows with the Proposed Development during construction, and with major committed development traffic flows); and
- Cumulative peak construction year 'with construction' scenario (assuming drill and blast tunnelling between Braint and Tŷ Fodol) (representative of 2023) (modelled with 2016 background data, 2016 traffic emission factors and 2023 traffic flows with the Proposed Development during construction, and with major committed development traffic flows).

Emergency Generator Emissions Assessment

1.1.4 The Proposed Development would require 12 MVA (or 9.6 MW) in power generation to facilitate the sinking of shafts and the construction of the tunnel beneath the Menai Strait. The primary power source for these works would be an extension to the existing Scottish Power Manweb (SPM). The secondary power source, required only in the event of any failure to the primary power source, would be available from a series of diesel-fired generators.

1.1.5 Emissions from the emergency diesel-fired generator sources have the potential to impact on local air quality and have been modelled using the current version of the dispersion model ADMS 5.2 (v5.2.2). ADMS 5.2 is dispersion modelling software that is commonly used to quantify industrial emissions contributions to total pollutant concentrations for projects across the UK and overseas.

1.1.6 The scenarios considered within the dispersion modelling exercise for emergency generator emissions are:

- Peak construction year 'with construction' scenario (TBM from Braint to Tŷ Fodol) six diesel-fired emergency generators (totalling 9

MVA (7.2 MW)) at the drive shaft at Braint and two diesel-fired emergency generators (totalling 3 MVA (2.4 MW)) at the reception shaft at Tŷ Fodol; and

- Peak construction year 'with construction' scenario (TBM from Tŷ Fodol to Braint) six diesel-fired emergency generators (totalling 9 MVA (7.2 MW)) at the drive shaft at Tŷ Fodol and two diesel-fired emergency generators (totalling 3 MVA (2.4 MW)) at the reception shaft at Braint.

- Peak construction year 'with construction' scenario (drill and blast between Braint and Tŷ Fodol) assuming up to six diesel-fired emergency generators (totalling 9 MVA (7.2 MW)) at the shaft sites at Braint and Tŷ Fodol.

2 Air Quality Sensitive Receptors

1.2.1 The dispersion modelling assessment has predicted the contribution of road traffic emissions and emergency generator emissions to total pollutant concentrations at a number of selected air quality sensitive receptors. These receptors include human health and ecologically sensitive locations that are close to roads used by Proposed Development construction traffic and close to the emergency generators.

1.2.2 The selected receptors are considered representative of other nearby sensitive receptors that have not been explicitly modelled, but can be expected to experience a similar level of impact to those reported.

Human Health Sensitive Receptors

1.2.3 The human health sensitive receptors are listed in Table 14.3.1 and the locations shown on Figure 14.4. The pollutant impacts predicted at the human health sensitive receptors located in close proximity to the Braint and Tŷ Fodol Construction Compounds, are from the combined emissions of additional construction phase vehicle movements and emergency generator emissions. Elsewhere within the study area, annual mean impacts predicted are as a result of additional construction phase vehicle movements only, where they have the potential to have a significant effect. Impacts to hourly mean NO_2 and daily mean PM_{10} concentrations are predicted for emergency generators alone, in line with IAQM guidance, at receptors located closest to the Braint and Tŷ Fodol Construction Compounds.

Table 14.3.1: Human Health Sensitive Receptors

Receptor ID	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
Section A - Wylfa to Rhosgoch				
RT2/ 12431	229456	379255	Residential property south of A5	Construction Vehicles[1]
RT2/ 12443	229530	379321	Residential property east of A5025	Construction Vehicles[1]
RT2/	231648	382193	Residential property east of	Construction

Table 14.3.1: Human Health Sensitive Receptors				
Receptor ID	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
12821			the A5025	Vehicles[1]
Section B – Rosgoch to Llandyfrydog				
No human health sensitive receptors located in this section that are within 200 m of a road that experiences an increase in traffic flow that could have a significant effect, or within the range of likely impacts from the emergency generator plant				
Section C – Llandyfrydog to B5110 north of Talwrn				
No human health sensitive receptors located in this section that are within 200 m of a road that experiences an increase in traffic flow that could have a significant effect, or within the range of likely impacts from the emergency generator plant				
Section D – B5110 North of Talwrn to Ceint				
R4/ 01250	246757	375546	Residential property north of B5109	Construction Vehicles[1]
RT4/ 13208	245041	373845	Residential property north of the A55	Construction Vehicles
RT4/ 13212	245253	374242	Residential property off the A5114	Construction Vehicles
Section E – Ceint to the Afon Braint				
R5/ 00071	246970	372739	Residential property north of the A55	Construction Vehicles
R5 /02601	250449	372070	Residential property off the A55, near Star	Construction Vehicles
R5/ 02641	250640	371023	Residential property 900 m west of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 02726	251090	372034	Residential property off the A55, at Star	Construction Vehicles
Section F (IACC section)				
R5/ 02815	251334	370703	Residential property, 380 m south of Braint Construction Compound	Emergency Generators
R5/ 02878	251642	370384	Residential property, 550 m south of Braint Construction	Emergency Generators

Table 14.3.1: Human Health Sensitive Receptors				
Receptor ID	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
			Compound	
R5/ 02917	251806	371947	Residential property off the A55, 850 m north of Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 02987	251914	371174	Residential property, 200 m north of Braint Construction Compound	Emergency Generators
R5/ 03134	252023	371437	Residential property, 500 m north of Braint Construction Compound	Emergency Generators
R5/ 03353	252165	371764	Residential property off the A5 and A55, 850 m north of Residential property 850 m north of Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 03423	252216	371121	Residential property off Pont Ronwy Link Road, 500 m east of Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 03460	252270	371693	Residential property off the A5, 870 m north-east of Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 03755	252432	370927	Residential property off the Pont Ronwy Link Road and A4080, 700 m east of Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 05159	252970	371423	Residential property off the A4080, 1,300 m north-east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 05343	253056	372289	Residential property off the A55, 1,850 m north-east of the Braint Construction	Construction Vehicles and Emergency

Table 14.3.1: Human Health Sensitive Receptors				
Receptor ID	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
			Compound	Generators
R5/ 05644	253201	372315	Residential property off the A55, 1,870 m north-east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 05837	253300	372382	Residential property off the A55, 1,890 m north-east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 06474	253625	371449	Residential property off the A5, 1,950 m east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 06661	253719	371524	Residential property off the A5, 2,000 m east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 06714	253773	371933	Residential property off the A55, 2,250 m north-east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 06835	253875	371950	Residential property and care home off the A55, 2,275 m north-east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 06863	253915	371648	Residential property off the A55, 2,280 m east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
R5/ 06907	253990	371367	Residential property off the A55, 2,295 m east of the Braint Construction Compound	Construction Vehicles and Emergency Generators
Section F Afon Braint to Pentir (Gwynedd Council section)				

Table 14.3.1: Human Health Sensitive Receptors				
Receptor ID	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
R5/ 06922	254033	367777	Residential property 800 m south of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 07156	254409	368565	Residential property 230 m west of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 07180	254463	370354	Residential property off the A55 and 1,900 m north of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 07195	254520	370641	Residential property off the A55 and 2,170 m north of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 07322	254757	368001	Residential property 310 m south of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 07470	254793	370110	Residential property off the A55 and 1,600 m north of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 07577	254914	368854	Residential property 480 m north of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 07647	254972	368402	Residential property 240 m east of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 07783	255041	369631	Residential property adjacent to the A55 and 1,240 m north of Tŷ Fodol	Construction Vehicles and Emergency

Table 14.3.1: Human Health Sensitive Receptors				
Receptor ID	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
			Construction Compound	Generators
R5/ 08574	255296	367998	Residential property 690 m east of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ 11751	257075	369344	Residential property adjacent to the A55 and 2,500 m north-east of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
R5/ AQ01	260929	370351	Residential property adjacent to the A55 and 6,500 m north-east of Tŷ Fodol Construction Compound	Construction Vehicles and Emergency Generators
[1] Cumulative impacts only				

Ecologically Sensitive Receptors

1.2.4 The ecologically sensitive receptors considered are listed in Table 14.3.2 and the locations shown on Figure 14.4. Long-term concentrations of oxides of nitrogen (NO_X), sulphur dioxide (SO_2), and deposition rates for nutrient nitrogen, acid as nitrogen and acid as sulphur, are reported for ecological receptors located within 10 km of the Braint and Tŷ Fodol Construction Compounds, and include the combined contribution of emissions from construction phase vehicle movements and emergency generators. Long-term pollutant concentrations at ecological receptors located beyond 10 km from the Braint and Tŷ Fodol Construction Compounds include the Proposed Development emissions associated with construction-related vehicle movements only. Impacts to daily mean NO_X concentrations are predicted for emergency generator emissions alone at receptors located within 10 km of the Braint and Tŷ Fodol Construction Compounds.

Table 14.3.2: Ecologically Sensitive Receptors				
Site Name	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
Section A - Wylfa to Rhosgoch				
Beddmanarch-Cymyran SSSI	231581	382147	Nearest location of the lowland mixed deciduous woodland to the main road source (55 m back)	Construction Vehicles[1]
	231572	382150	70 m back	
	231562	382153	80 m back	
	231550	382156	90 m back	
	231539	382159	100 m back	
	231527	382161	1,100 m back	
Section B – Rosgoch to Llandyfrydog				
No ecological sensitive receptors located in this section that are within 200 m of a road that experiences an increase in traffic flow that could have a significant effect, or within the range of likely impacts from the emergency generator plant				
Section C – Llandyfrydog to B5110 North of Talwrn				
Corsydd Mon SAC at Capel Coch	246391	382256	Heathland and fen closest to the OHL Access Track	Construction Vehicles
Corsydd Mon SAC at Llanddyfnan (west)	249926	378760	Heathland and fen 8900 m north - north-west of the Braint Construction Compound emergency generators	Emergency Generators

Table 14.3.2: Ecologically Sensitive Receptors				
Site Name	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
Corsydd Mon SAC at Llanddyfnan (east)	251058	378510	Heathland and fen 8,900 m north – north-west of the Braint Construction Compound emergency generators	Emergency Generators
Section D – B5110 North of Talwrn to Ceint				
Corsydd Mon SAC (west of Talwrn)	247744	376979	Heathland and fen 7,400 m north – north-west of the Braint Construction Compound emergency generators	Emergency Generator
Corsydd Mon SAC (north of Talwrn)	248995	377636	Heathland and fen 7,900 m north – north-west of the Braint Construction Compound emergency generators	Emergency Generator
Corsydd Mon SAC (east of Talwrn)	249836	376854	Heathland and fen 7,200 m north – north-west of the Braint Construction Compound emergency generators	Emergency Generator
Cors Ddyga SSSI	245325	373513	Nearest location of the fen and swamp to the main road source	Construction Vehicles
	245322	373509	5 m back	
	245318	373505	10 m back	
	245315	373501	15 m back	
	245312	373497	20 m back	
	245309	373494	25 m back	
	245306	373490	30 m back	

Table 14.3.2: Ecologically Sensitive Receptors				
Site Name	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
	245303	373487	35 m back	
	245300	373483	40 m back	
	245297	373479	45 m back	
	245294	373475	50 m back	
	245261	373437	100 m back	
	245229	373399	150 m back	
	245196	373362	200 m back	
Section E – Ceint to the Afon Braint				
No ecological sensitive receptors located in this section that are within 200 m of a road that experiences an increase in traffic flow that could have a significant effect, or within the range of likely impacts from the emergency generator plant				
Section F Afon Braint to Pentir (IACC Section)				
Ancient Semi Natural Woodland (Ref: 25877)	251103	370394	850 m south-west of Braint Construction Compound emergency generators	Emergency Generators
Restored Ancient Woodland Site (Ref: 24261)	252523	370970	775 m east of Braint Construction Compound emergency generators	Emergency Generators
Plantation on	251550	370369	680 m south of Braint Tunnel Head House and Cable	Emergency

Table 14.3.2: Ecologically Sensitive Receptors				
Site Name	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
Ancient Woodland Site (Ref: 43628)			Sealing End Compound emergency generator	Generators
Section F Afon Braint to Pentir (Gwynedd Council section)				
Coedydd Afon Menai SSSI (northeast of A55)	254259	370888	Nearest location of the lowland mixed deciduous woodland to the main road source	Construction Vehicles and Emergency Generators
	254263	370890	5 m back	
	254267	370893	10 m back	
	254272	370895	15 m back	
	254276	370897	20 m back	
	254281	370899	25 m back	
	254286	370901	30 m back	
	254291	370903	35 m back	
	254295	370905	40 m back	
	254300	370908	45 m back	
	254304	370910	50 m back	
	254351	370932	100 m back	
	254396	370956	150 m back	

Table 14.3.2: Ecologically Sensitive Receptors

Site Name	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
	254440	370984	200 m back	
Coedydd Afon Menai SSSI (southwest of A55)	254146	370850	Nearest location of the lowland mixed deciduous woodland to the main road source	Construction Vehicles and Emergency Generators
	254141	370849	5 m back	
	254136	370847	10 m back	
	254132	370846	15 m back	
	254127	370844	20 m back	
	254122	370842	25 m back	
	254117	370841	30 m back	
	254113	370839	35 m back	
	254108	370837	40 m back	
	254103	370836	45 m back	
	254098	370834	50 m back	
	254054	370821	100 m back	
	254002	370808	150 m back	
	253951	370796	200 m back	

Table 14.3.2: Ecologically Sensitive Receptors

Site Name	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
Plantation on Ancient Woodland Site (Ref: 43562)	254260	368700	Woodland 400 m west – north-west of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Ancient Semi Natural Woodland (Ref: 25071)	253724	368549	Woodland 825 m west of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Plantation on Ancient Woodland Site (Ref: 43561)	254306	368426	Woodland 240 m west of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Ancient Woodland Site of Unknown Category (Ref: 48976)	254580	368248	Woodland 190 m south of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Plantation on Ancient Woodland Site (Ref: 43552)	254340	368195	Woodland 310 m south-west of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Plantation on Ancient Woodland Site (Ref: 43538)	255673	368125	Woodland1.2 km east of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Plantation on Ancient Woodland Site (Ref: 43537)	255568	367878	Woodland 1.2 km east – south-east of Tŷ Fodol Construction Compound emergency generators	Emergency Generators

Table 14.3.2: Ecologically Sensitive Receptors

Site Name	Modelled Grid Reference		Description	Emissions Considered
	X	Y		
Plantation on Ancient Woodland Site (Ref: 43555)	254534	367580	Woodland 850 m south of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Eryri SAC	263433	370150	Siliceous alpine and boreal grasslands 9 km east – north-east of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Eryri SAC	262648	367915	Siliceous alpine and boreal grasslands 8 km east of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Eryri SAC	258657	366517	Siliceous alpine and boreal grasslands 4.5 km south-east of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Eryri SAC	257686	364888	Siliceous alpine and boreal grasslands 4.5 km south-east of Tŷ Fodol Construction Compound emergency generators	Emergency Generators
Eryri SAC	258930	362376	Siliceous alpine and boreal grasslands 7.5 km south-east of Tŷ Fodol Construction Compound emergency generators	Emergency Generators

[1] Cumulative impacts only

3 Meteorological Conditions

1.3.1 The dispersion modelling of both road traffic emissions and emergency generator emissions requires the input of hourly sequential meteorological data measured at a site that is representative of the study area. This is usually achieved by selecting a meteorological station as close to the site as possible, although other stations may be used if the local terrain and conditions vary considerably or if the closest station does not provide sufficient data.

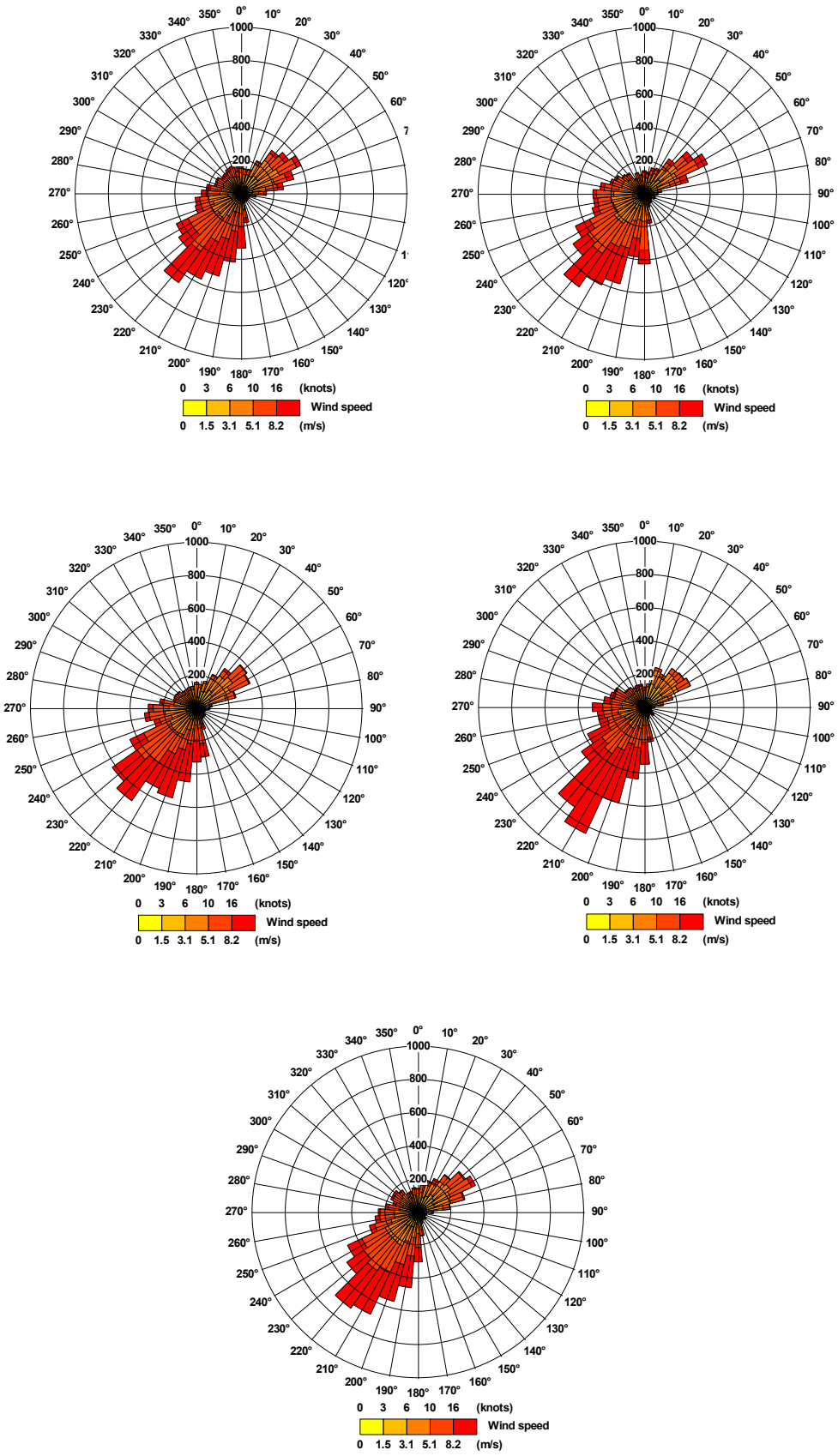
1.3.2 One year of hourly sequential observation data (2016) from Mona Meteorological Station, on Anglesey, has been used to quantify road traffic emissions impacts. 2016 data has been used to match the year of traffic data used to inform the assessment, as well as the year of projected baseline NO_2 measurement data. The meteorological station is located in Bodffordd in central Anglesey, and conditions there are considered to be representative of those experienced in the wider air quality study area.

1.3.3 The dispersion of emissions from a point source (i.e. generator stack/exhaust) is largely dependent on atmospheric stability and turbulent mixing in the atmosphere, which in turn are dependent on wind speed and direction, ambient temperature, cloud cover and the friction created by buildings and local terrain. Therefore, a further four years of hourly sequential observation data (2012 – 2015, as well as 2016) from Mona Meteorological Station have been used to quantify potential emergency generator impacts at the Braint and Tŷ Fodol Construction Compounds. The worst year of impact predicted at each receptor is then reported. A meteorological data sensitivity test is tabulated in Sub-Appendix 14.3.A.

1.3.4 Wind rose plots for the meteorological data used in the assessment are presented in Figure 14.3.1 below.

1.3.5 The plots show that each year of meteorological data considered is fairly consistent, with a large predominance of winds blowing from the south-west, which is typical of conditions across much of the UK. However, winds could blow from all directions over the course of a year.

Figure 14.3.1: Mona Wind Direction and Wind Speed Plot (2012 - 2016)



4 Road Traffic Emissions Modelling

1.4.1 The model conditions that are specific to the quantification of road traffic emissions impacts that have been used for this assessment are summarised in Table 14.3.3. Further model inputs are then described in more detail in the following paragraphs.

Table 14.3.3: ADMS Roads – General Model Conditions

Variables	ADMS Roads Model Input
Surface roughness at source	0.5 m
Minimum Monin-Obukhov length for stable conditions	10 m
Terrain types	Flat
Receptor locations	X, Y coordinates determined by GIS, Z = 1.5 m
Traffic data	Annual Average Daily Traffic (AADT) flow data including total flow, %HGV and average speed for modelled scenarios
Emissions	NO_X, PM_{10}, $PM_{2.5}$
Emission factors	EFT Version 8.0.1 emission factor dataset (projected rates for 2016 (base EFT year) and 2016 (base project year) considered)
Background pollutant concentrations	Defra background maps (projected concentrations for 2016)
Meteorological data	1 year (2016) hourly sequential data from Mona Meteorological Station
Emission profiles	No - robustly assumes an even distribution of emissions over 24 hours
Receptors	Selected human sensitive and ecologically receptors (See Table 14.3.1 and Table 14.3.2)
Model output	Long-term annual mean NO_X concentrations Long-term annual mean PM_{10} concentrations Long-term annual mean $PM_{2.5}$ concentrations

1.5 TRAFFIC DATA

1.5.1 The dispersion model ADMS Roads calculates the contribution of pollutants emitted from vehicles using the following parameters:

- Traffic volume: The number of vehicles travelling a length of road in a given time will affect the subsequent emissions and dispersion of pollutants;
- Fleet composition: The proportion of Heavy Goods Vehicles (HGVs) (including buses) to Light Goods Vehicles (LGVs) will affect the mass emissions of pollutants; and
- Fleet velocity: The speed of the fleet affects the mass emissions of pollutants.

1.5.2 Traffic data was provided for the air quality assessment and is summarised in Sub-Appendix 14.3.A. The data was screened to identify road links that are predicted to experience an increase in traffic flow that has the potential to have a significant effect on local air quality, in line with current guidance (Ref 14.15).

1.5.3 The baseline AADT flow data is based on 24-hour traffic count data gathered over several weeks at locations across Anglesey and Gwynedd (see Chapter 13 Traffic and Transport (**Document 5.13**)). The future baseline traffic data incudes the year on year growth anticipated for Anglesey and Gwynedd, through the application of TEMPRO factors. The construction phase traffic data also includes Proposed Development-related vehicle movements. The cumulative scenario traffic data includes flows associated with major proposed and committed developments in the area, including the Proposed Wylfa Newydd Project.

1.6 VEHICLE EMISSIONS

1.6.1 Emission factors have been sourced from the Emissions Factors Toolkit (EFT) Version 8.0.1 (Ref 14.21). The baseline scenario was modelled using emission rates projected for 2016, to match the baseline traffic data, the year of projected annual mean measurement data and the year of hourly sequential meteorological data.

1.6.2 The EFT includes emission rates projected for future years, which show a decrease in vehicle emissions based on assumptions on improvements in emissions technology and the evolution of the UK vehicle fleet. However, there is some uncertainty in the rate at which emissions rates are improving. It has therefore been assumed in this assessment that the 2016 emission factors used to represent the baseline (2016) conditions would be representative of the future year (2023) scenarios. This is considered a robust assumption for 2023, as some improvement in emissions technology and evolution of the vehicle fleet is likely to occur between now and 2023.

1.7 BACKGROUND POLLUTANT CONCENTRATIONS

1.7.1 The background pollutant concentration data used in the assessment to represent background conditions at human sensitive receptors has been sourced from Defra's background pollutant concentration maps (Ref 14.20). Background data was obtained for the 1 km by 1 km grid squares within which the selected air quality sensitive receptors are located, for the year 2016, the baseline year of this assessment.

1.7.2 The background pollutant concentration maps include background concentrations for future years, which show a gradual decrease in concentrations. However, there is some uncertainty in the rate at which background pollutant concentrations are improving. Therefore, it has been assumed in this assessment that the 2016 background pollutant concentrations used to represent the baseline (2016) conditions would be representative of the future year (2023) scenarios. This is considered a robust assumption for 2023, as some improvement in background pollutant concentrations could potentially occur between now and 2023. The background data used in the assessment of road traffic emissions at human sensitive receptors are presented in Table 14.3.4.

Table 14.3.4: Background Pollutant Concentration Data – Human Health Sensitive Receptors

Receptor ID	Modelled Grid Reference		2016 Concentration (µg/m^3)		
	X	Y	NO_2	PM_{10}	$PM_{2.5}$
Section A - Wylfa to Rhosgoch					
RT2/ 12431[1]	229456	379255	4.7	8.9	5.7
RT2/ 12443[1]	229530	379321	4.7	8.9	5.7
RT2/ 12821[1]	231648	382193	3.8	9.1	6.0
Section B – Rosgoch to Llandyfrydog					
No human health sensitive receptors located in this section that are within 200 m of a road that experiences an increase in traffic flow that could have a significant effect, or within the range of likely impacts from the emergency generator plant					
Section C – Llandyfrydog to B5110 North of Talwrn					
No human health sensitive receptors located in this section that are within 200 m of a road that experiences an increase in traffic flow that could have a significant effect, or within the range of likely impacts from the emergency generator plant					
Section D – B5110 North of Talwrn to Ceint					

Table 14.3.4: Background Pollutant Concentration Data – Human Health Sensitive Receptors					
Receptor ID	Modelled Grid Reference		2016 Concentration (µg/m^3)		
	X	Y	NO_2	PM_{10}	$PM_{2.5}$
R4/ 01250[1]	246757	375546	6.1	10.0	6.5
RT4/ 13208	245041	373845	5.6	9.0	5.7
RT4/ 13212	245253	374242	5.1	9.1	5.8
Section E – Ceint to the Afon Braint					
R5/ 00071	246970	372739	4.9	9.2	5.9
R5 /02601	250449	372070	5.7	9.5	6.1
R5/ 02641	250640	371023	5.1	9.5	6.1
R5/ 02726	251090	372034	4.8	9.5	6.3
Section F Afon Braint to Pentir (IACC section)					
R5/ 02815	251334	370703	4.1	8.7	5.6
R5/ 02878	251642	370384	4.1	8.7	5.6
R5/ 02917	251806	371947	6.2	9.5	6.1
R5/ 02987	251914	371174	6.2	9.5	6.1
R5/ 03134	252023	371437	6.5	10.4	7.1
R5/ 03353	252165	371764	6.5	10.4	7.1
R5/ 03423	252216	371121	6.5	10.4	7.1
R5/ 03460	252270	371693	6.5	10.4	7.1
R5/ 03755	252432	370927	4.3	8.9	5.7
R5/ 05159	252970	371423	6.5	10.4	7.1
R5/ 05343	253056	372289	6.1	9.5	6.2
R5/ 05644	253201	372315	6.1	9.5	6.2
R5/ 05837	253300	372382	6.1	9.5	6.2
R5/ 06474	253625	371449	7.3	10.1	6.7
R5/ 06661	253719	371524	7.3	10.1	6.7
R5/ 06714	253773	371933	7.3	10.1	6.7
R5/ 06835	253875	371950	7.3	10.1	6.7
R5/ 06863	253915	371648	7.3	10.1	6.7
R5/ 06907	253990	371367	7.3	10.1	6.7

Table 14.3.4: Background Pollutant Concentration Data – Human Health Sensitive Receptors					
Receptor ID	Modelled Grid Reference		2016 Concentration (µg/m^3)		
	X	Y	NO_2	PM_{10}	$PM_{2.5}$
Section F Afon Braint to Pentir (Gwynedd Council section)					
R5/ 06922	254033	367777	4.2	9.0	5.9
R5/ 07156	254409	368565	4.9	8.9	5.8
R5/ 07180	254463	370354	7.7	9.6	6.3
R5/ 07195	254520	370641	7.7	9.6	6.3
R5/ 07322	254757	368001	4.9	8.9	5.8
R5/ 07470	254793	370110	7.7	9.6	6.3
R5/ 07577	254914	368854	4.9	8.9	5.8
R5/ 07647	254972	368402	4.9	8.9	5.8
R5/ 07783	255041	369631	7.5	9.9	6.4
R5/ 08574	255296	367998	4.2	8.8	5.7
R5/ 11751	257075	369344	6.8	10.3	6.8
R5/ AQ01	260929	370351	7.3	10.6	7.1
[1] Cumulative impacts only					

1.7.3 The background pollutant concentration and deposition data used in the assessment to represent background conditions at ecologically sensitive receptors has been sourced from the Air Pollution Information System (APIS) background pollutant concentration maps (Ref 14.32). Background data was obtained for the 5 km by 5 km grid squares within which the selected air quality sensitive receptors are located, for the year 2016, the base year of the current APIS background maps. The 2016 data was used to represent conditions in 2016 and 2023, in light of uncertainty in the projected improvements in background pollutant concentrations of coming years. Again, this is considered to be a robust approach. The background data used in the assessment of emissions impacts at ecologically sensitive receptors are presented in Table 14.3.5.

Table 14.3.5: Background Pollutant Concentration Data – Ecologically Sensitive Receptors								
Receptor ID	Ecological Receptor	Modelled Grid Reference		2016 Concentration and Deposition Rate (µg/m^3 / kgN/ha/yr / keqN/ha/yr)				
		X	Y	NO_X	N Dep	A Dep	A(N) Dep	A(S) Dep
Section A - Wylfa to Rhosgoch								
AQ/A/E01	Beddmanarch-Cymyran SSSI[1]	231581	382147	6.4	13.0	1.0	0.9	0.13
Section B – Rosgoch to Llandyfrydog								
	No ecologically sensitive receptors located in this section that are within 200 m of a road that experiences an increase in traffic flow that could have a significant effect, or within the range of likely impacts from the emergency generator plant							
Section C – Llandyfrydog to B5110 North of Talwrn								
AQ/C/E01	Corsydd Mon SAC at Capel Coch	246391	382256	5.7	14.1	1.1	1.0	0.16
AQ/C/E02	Corsydd Mon SAC at Llanddyfnan (west)	249926	378760	6.2	15.5	1.23	1.11	0.16
AQ/C/E03	Corsydd Mon SAC at Llanddyfnan (east)	251058	378510	6.3	14.0	1.13	1.00	0.13
Section D – B5110 North of Talwrn to Ceint								
AQ/D/E01	Corsydd Mon SAC (west of Talwrn)	247744	376979	7.0	15.5	1.23	1.11	0.16
AQ/D/E02	Corsydd Mon SAC (north of Talwrn)	248995	377636	6.6	15.5	1.23	1.11	0.16

Table 14.3.5: Background Pollutant Concentration Data – Ecologically Sensitive Receptors								
Receptor ID	Ecological Receptor	Modelled Grid Reference		2016 Concentration and Deposition Rate (µg/m^3 / kgN/ha/yr / keqN/ha/yr)				
		X	Y	NO_X	N Dep	A Dep	A(N) Dep	A(S) Dep
AQ/D/E03	Corsydd Mon SAC (east of Talwrn)	249836	376854	6.6	15.5	1.23	1.11	0.16
AQ/D/E04	Cors Ddyga SSSI	245325	373513	9.1	14.2	1.16	1.03	0.17
Section F Afon Braint to Pentir (IACC section)								
AQ/F(A)/E01	Ancient Semi Natural Woodland (Ref: 25877)	251103	370394	7.1	32.2	2.45	2.3	0.2
AQ/F(A)/E02	Restored Ancient Woodland Site (Ref: 24261)	252206	370542	7.3	32.2	2.45	2.3	0.2
AQ/F(A)/E03	Plantation on Ancient Woodland Site (Ref: 43628)	251550	370369	7.1	32.2	2.45	2.3	0.2
Section F Afon Braint to Pentir (Gwynedd Council section)								
AQ/F(G)/E01	Coedydd Afon Menai SSSI (north-east of A55)	254259	370888	11.7	32.2	2.45	2.30	0.20
AQ/F(G)/E02	Coedydd Afon Menai SSSI (south-west of A55)	254146	370850	11.7	32.2	2.45	2.30	0.20

Table 14.3.5: Background Pollutant Concentration Data – Ecologically Sensitive Receptors								
Receptor ID	Ecological Receptor	Modelled Grid Reference		2016 Concentration and Deposition Rate (µg/m^3 / kgN/ha/yr / keqN/ha/yr)				
		X	Y	NO_X	N Dep	A Dep	A(N) Dep	A(S) Dep
AQ/F(G)/E03	Plantation on Ancient Woodland Site (Ref: 43562)	254260	368700	8.2	21.3	1.68	1.52	0.21
AQ/F(G)/E04	Ancient Semi Natural Woodland (Ref: 25071)	253724	368549	7.7	21.3	1.68	1.52	0.21
AQ/F(G)/E05	Plantation on Ancient Woodland Site (Ref: 43561)	254306	368426	8.2	21.3	1.68	1.52	0.21
AQ/F(G)/E06	Ancient Woodland Site of Unknown Category (Ref: 48976)	254580	368248	8.2	21.3	1.68	1.52	0.21
AQ/F(G)/E07	Plantation on Ancient Woodland Site (Ref: 43552)	254340	368195	8.2	21.3	1.68	1.52	0.21
AQ/F(G)/E08	Plantation on Ancient Woodland Site (Ref: 43538)	255673	368125	7.7	23.8	1.91	1.70	0.29
AQ/F(G)/E09	Plantation on Ancient Woodland Site (Ref: 43537)	255568	367878	7.1	23.8	1.91	1.70	0.29

Table 14.3.5: Background Pollutant Concentration Data – Ecologically Sensitive Receptors								
Receptor ID	Ecological Receptor	Modelled Grid Reference		2016 Concentration and Deposition Rate (µg/m^3 / kgN/ha/yr / keqN/ha/yr)				
		X	Y	NO_X	N Dep	A Dep	A(N) Dep	A(S) Dep
AQ/F(G)/E10	Plantation on Ancient Woodland Site (Ref: 43555)	254534	367580	7.0	21.3	1.68	1.52	0.21
AQ/F(G)/E11	Eryri SAC (south of Crymlyn)	263433	370150	6.9	20.4	1.66	1.46	0.28
AQ/F(G)/E12	Eryri SAC (north of Bethesda)	262648	367915	7.2	25.9	2.16	1.85	0.42
AQ/F(G)/E13	Eryri SAC (west of Bethesda)	258657	366517	6.6	23.8	1.91	1.70	0.29
AQ/F(G)/E14	Eryri SAC (south of Rhiwlas)	257686	364888	6.7	23.5	1.95	1.68	0.36
AQ/F(G)/E15	Eryri SAC (south of Deiniolen)	258930	362376	6.5	23.5	1.95	1.68	0.36
[1] Cumulative impacts only								

1.8 NO_X TO NO_2 CONVERSION

1.8.1 For road traffic emissions calculations, a 'NO_X to NO_2' conversion spreadsheet has been made available by the Defra as a tool to calculate the road NO_2 contribution from modelled road NO_X contributions (Ref 14.34). The tool comes in the form of a Microsoft Excel spreadsheet and uses local authority specific data to calculate annual mean concentrations of NO_2 from dispersion model output values of annual mean concentrations of NO_X and background NO_2 concentrations.

1.9 MODEL VERIFICATION

Introduction

1.9.1 To account for model bias, Defra guidance (Ref 14.18) suggests model verification should be undertaken, whereby modelled predictions are made at set locations where there is measurement data available. The variation between modelled predictions and monitored concentrations at these locations is then analysed and the resultant factor(s) applied to modelled output at other representative locations, to account for model bias.

Measurement Data

1.9.2 The measurement data used for model verification has been obtained from a Project-specific baseline diffusion tube survey. The survey was set up in March 2017, before the Proposed Development Construction Traffic Routes were confirmed. However, diffusion tubes were located adjacent to roads that were assumed likely to experience construction phase traffic movements. The analysis certificates provided by the laboratory are shown in Sub-Appendix 14.3.C.

Annualisation

1.9.3 The baseline data currently available from the Project-specific survey accounts for a period of 8 - 12 months depending on the measurement location. Periods of less than 12 months were due to diffusion tubes being lost on some months. This period mean data has been 'annualised' to a projected calendar annual mean for 2016, following the method described in Defra guidance (Ref 14.18).

1.9.4 This process requires obtaining data from continuous monitoring stations for the same 12-month period in which the diffusion tube measurements were gathered, as well as for the full calendar year that the measured values are to be projected to, and comparing the difference between the two datasets. The guidance states that the monitoring data should be

gathered from continuous monitoring stations located within 50 miles of the survey area. In this instance, there are no continuous monitoring stations within 50 miles of the survey area. Instead, an analysis of the NO_2 data available on the Welsh Air Quality website (Ref 14.28) for all continuous monitoring stations in Wales, where sufficient data (>85%) are available for the survey period and the 2016 calendar year, was undertaken. This process is summarised in Table 14.3.6. Due to the data gaps as a result of missing tubes in some months, multiple factors are calculated based on the periods of survey data gathered at each diffusion tube measurement location.

Table 14.3.6: Calculating an Annualisation Factor

Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Survey Period 07/03/17 to 05/03/18 (12 months of data)				
Aston Hill	Rural	2.2	3.7	1.697
Caerphilly White Street	Roadside	29.0	34.4	1.186
Caerphilly Blackwood High Street	Roadside	31.5	28.6	0.907
Hafod-yr-ynys Roadside	Kerbside	67.5	69.4	1.028
Nantgarw Road	Roadside	25.7	29.2	1.138
Cardiff Centre	Urban Centre	19.0	23.3	1.227
Chepstow A48	Roadside	33.7	34.8	1.033
Cwmbran	Urban Background	11.5	12.9	1.124
V Glamorgan Windsor Road Penarth	Roadside	28.3	28.4	1.004
Newport M4 Junction 25	Roadside	42.7	45.8	1.072
Neath Cimla Road/Victoria Gardens	Roadside	36.8	37.8	1.028
Port Talbot Margam	Urban Industrial	14.9	17.4	1.162
Rhondda-Cynon-Taf Broadway	Roadside	26.4	28.5	1.082

[1] All station names are those given on the Air Quality in Wales website.

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Rhondda Mountain Ash	Roadside	57.6	53.1	0.921
Swansea Station Court High Street	Roadside	37.0	51.7	1.400
Swansea Roadside	Roadside	23.3	30.4	1.304
Swansea Morriston	Roadside	26.4	29.7	1.124
Swansea Hafod DOAS	Roadside	36.9	44.1	1.197
Swansea St Thomas DOAS	Roadside	43.2	36.6	0.848
Swansea Cwm Level Park	Roadside	12.9	16.4	1.268
			Average Annualisation Factor	**1.164**
Survey Period 07/03/17 to 31/05/17 & 28/06/17 to 05/03/18 (11 months of data)				
Aston Hill	Rural	2.2	3.7	1.695
Caerphilly White Street	Roadside	30.0	34.4	1.148
Caerphilly Blackwood High Street	Roadside	32.3	28.6	0.884
Hafod-yr-ynys Roadside	Kerbside	68.5	69.4	1.014
Nantgarw Road	Roadside	26.4	29.2	1.107
Cardiff Centre	Urban Centre	19.6	23.3	1.191
Chepstow A48	Roadside	34.2	34.8	1.017
Cwmbran	Urban background	12.0	12.9	1.082
V Glamorgan Windsor Road Penarth	Roadside	28.8	28.4	0.985
Newport M4 Junction 25	Roadside	43.3	45.8	1.058
Neath Cimla Road/Victoria Gardens	Roadside	37.6	37.8	1.007
Port Talbot Margam	Urban Industrial	15.2	17.4	1.146

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Rhondda-Cynon-Taf Broadway	Roadside	27.0	28.5	1.055
Rhondda Mountain Ash	Roadside	58.7	53.1	0.903
Swansea Station Court High Street	Roadside	36.2	51.7	1.431
Swansea	Roadside	24.1	30.4	1.262
Swansea Morriston	Roadside	26.7	29.7	1.113
Swansea Hafod DOAS	Roadside	38.1	44.1	1.157
Swansea St Thomas DOAS	Roadside	45.1	36.6	0.813
Swansea Cwm Level Park	Roadside	13.4	16.4	1.222
			Average Annualisation Factor	**1.141**
Survey Period 07/03/17 to 02/08/17 & 30/08/17 to 05/03/18 (11 months of data)				
Aston Hill	Rural	2.3	3.7	1.592
Caerphilly White Street	Roadside	29.6	34.4	1.163
Caerphilly Blackwood High Street	Roadside	32.2	28.6	0.888
Hafod-yr-ynys Roadside	Kerbside	68.0	69.4	1.020
Nantgarw Road	Roadside	26.0	29.2	1.122
Cardiff Centre	Urban Centre	19.4	23.3	1.199
Chepstow A48	Roadside	34.2	34.8	1.016
Cwmbran	Urban background	12.0	12.9	1.082
V Glamorgan Windsor Road Penarth	Roadside	29.0	28.4	0.979
Newport M4 Junction 25	Roadside	42.3	45.8	1.083
Neath Cimla Road/Victoria Gardens	Roadside	36.7	37.8	1.031

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Port Talbot Margam	Urban Industrial	15.4	17.4	1.131
Rhondda-Cynon-Taf Broadway	Roadside	26.8	28.5	1.063
Rhondda Mountain Ash	Roadside	58.3	53.1	0.911
Swansea Station Court High Street	Roadside	38.0	51.7	1.361
Swansea	Roadside	24.1	30.4	1.260
Swansea Morriston	Roadside	27.3	29.7	1.088
Swansea Hafod DOAS	Roadside	38.1	44.1	1.157
Swansea St Thomas DOAS	Roadside	43.4	36.6	0.844
Swansea Cwm Level Park	Roadside	13.7	16.4	1.199
			Average Annualisation Factor	**1.131**
Survey Period 07/03/17 to 27/09/17 & 08/11/17 to 05/03/18 (11 months of data)				
Aston Hill	Rural	2.3	3.7	1.610
Caerphilly White Street	Roadside	29.0	34.4	1.188
Caerphilly Blackwood High Street	Roadside	30.1	28.6	0.949
Hafod-yr-ynys Roadside	Kerbside	67.1	69.4	1.034
Nantgarw Road	Roadside	25.1	29.2	1.162
Cardiff Centre	Urban Centre	19.0	23.3	1.228
Chepstow A48	Roadside	33.4	34.8	1.041
Cwmbran	Urban background	11.6	12.9	1.113
V Glamorgan Windsor Road Penarth	Roadside	28.5	28.4	0.996
Newport M4 Junction 25	Roadside	41.2	45.8	1.112

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Neath Cimla Road/Victoria Gardens	Roadside	36.5	37.8	1.036
Port Talbot Margam	Urban Industrial	14.9	17.4	1.162
Rhondda-Cynon-Taf Broadway	Roadside	26.3	28.5	1.084
Rhondda Mountain Ash	Roadside	57.7	53.1	0.920
Swansea Station Court High Street	Roadside	37.1	51.7	1.395
Swansea Roadside	Roadside	23.2	30.4	1.308
Swansea Morriston	Roadside	26.6	29.7	1.119
Swansea Hafod DOAS	Roadside	37.1	44.1	1.191
Swansea St Thomas DOAS	Roadside	42.6	36.6	0.859
Swansea Cwm Level Park	Roadside	13.2	16.4	1.242
			Average Annualisation Factor	**1.159**
Survey Period 07/03/17 to 05/01/18 (11 months of data)				
Aston Hill	Rural	2.0	3.7	1.800
Caerphilly White Street	Roadside	28.4	34.4	1.213
Caerphilly Blackwood High Street	Roadside	31.7	28.6	0.901
Hafod-yr-ynys Roadside	Kerbside	66.7	69.4	1.041
Nantgarw Road	Roadside	25.4	29.2	1.148
Cardiff Centre	Urban Centre	18.8	23.3	1.236
Chepstow A48	Roadside	33.3	34.8	1.043
Cwmbran	Urban background	11.2	12.9	1.151
V Glamorgan Windsor Road Penarth	Roadside	27.8	28.4	1.022

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Newport M4 Junction 25	Roadside	43.2	45.8	1.061
Cimla Road / Victoria Gardens	Roadside	36.6	37.8	1.035
Port Talbot Margam	Urban Industrial	14.7	17.4	1.181
Rhondda-Cynon-Taf Broadway	Roadside	25.8	28.5	1.107
Rhondda Mountain Ash	Roadside	56.5	53.1	0.939
Swansea Station Court High Street	Roadside	36.8	51.7	1.404
Swansea Roadside	Roadside	22.7	30.4	1.338
Swansea Morriston Roadside	Roadside	25.9	29.7	1.148
Swansea Hafod DOAS	Roadside	35.8	44.1	1.234
Swansea St Thomas DOAS	Roadside	42.4	36.6	0.865
Swansea Cwm Level Park	Roadside	12.2	16.4	1.345
			Average Annualisation Factor	**1.192**
Survey Period 07/03/17 to 02/011/17, 05/12/17 to 05/01/18 & 02/02/18 to 05/03/18 (10 months of data)				
Aston Hill	Rural	2.3	3.7	1.639
Caerphilly White Street	Roadside	26.9	34.4	1.279
Caerphilly Blackwood High Street	Roadside	28.6	28.6	1.000
Hafod-yr-ynys Roadside	Kerbside	64.4	69.4	1.077
Nantgarw Road	Roadside	23.5	29.2	1.244
Cardiff Centre	Urban Centre	17.2	23.3	1.355
Chepstow A48	Roadside	31.7	34.8	1.096

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Cwmbran	Urban background	10.6	12.9	1.224
V Glamorgan Windsor Road Penarth	Roadside	26.5	28.4	1.070
Newport M4 Junction 25	Roadside	42.5	45.8	1.078
Cimla Road / Victoria Gardens	Roadside	35.2	37.8	1.075
Port Talbot Margam	Urban Industrial	13.9	17.4	1.252
Rhondda-Cynon-Taf Broadway	Roadside	24.5	28.5	1.163
Rhondda Mountain Ash	Roadside	55.1	53.1	0.963
Swansea Station Court High Street	Roadside	36.7	51.7	1.412
Swansea Roadside	Roadside	22.2	30.4	1.367
Swansea Morriston Roadside	Roadside	24.5	29.7	1.213
Swansea Hafod DOAS	Roadside	35.5	44.1	1.244
Swansea St Thomas DOAS	Roadside	40.8	36.6	0.898
Swansea Cwm Level Park	Roadside	11.9	16.4	1.380
			Average Annualisation Factor	**1.224**
Survey Period 07/03/17 to 27/04/17,31/05/17 to 27/09/17 & 02/11/17 to 05/03/18 (10 months of data)				
Aston Hill	Rural	2.1	3.7	1.733
Caerphilly White Street	Roadside	29.7	34.4	1.160
Caerphilly Blackwood High Street	Roadside	31.1	28.6	0.920
Hafod-yr-ynys Roadside	Kerbside	67.9	69.4	1.023

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Nantgarw Road	Roadside	26.2	29.2	1.116
Cardiff Centre	Urban Centre	19.3	23.3	1.205
Chepstow A48	Roadside	34.4	34.8	1.010
Cwmbran	Urban background	12.0	12.9	1.077
V Glamorgan Windsor Road Penarth	Roadside	28.8	28.4	0.984
Newport M4 Junction 25	Roadside	42.0	45.8	1.092
Cimla Road / Victoria Gardens	Roadside	37.0	37.8	1.022
Port Talbot Margam	Urban Industrial	15.2	17.4	1.142
Rhondda-Cynon-Taf Broadway	Roadside	26.9	28.5	1.059
Rhondda Mountain Ash	Roadside	58.6	53.1	0.905
Swansea Station Court High Street	Roadside	35.6	51.7	1.453
Swansea Roadside	Roadside	23.2	30.4	1.310
Swansea Morriston Roadside	Roadside	26.9	29.7	1.103
Swansea Hafod DOAS	Roadside	36.9	44.1	1.195
Swansea St Thomas DOAS	Roadside	44.1	36.6	0.831
Swansea Cwm Level Park	Roadside	13.4	16.4	1.222
			Average Annualisation Factor	**1.149**
Survey Period 07/03/17 to 02/08/17,30/08/17 to 27/09/17 & 02/11/17 to 05/03/18 (10 months of data)				
Aston Hill	Rural	2.4	3.7	1.543
Caerphilly White Street	Roadside	29.7	34.4	1.159

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Caerphilly Blackwood High Street	Roadside	30.9	28.6	0.924
Hafod-yr-ynys Roadside	Kerbside	68.1	69.4	1.019
Nantgarw Road	Roadside	25.6	29.2	1.142
Cardiff Centre	Urban Centre	2.4	23.3	Erroneous
Chepstow A48	Roadside	34.1	34.8	1.018
Cwmbran	Urban background	12.0	12.9	1.076
V Glamorgan Windsor Road Penarth	Roadside	29.3	28.4	0.968
Newport M4 Junction 25	Roadside	40.7	45.8	1.126
Cimla Road / Victoria Gardens	Roadside	36.5	37.8	1.036
Port Talbot Margam	Urban Industrial	15.4	17.4	1.128
Rhondda-Cynon-Taf Broadway	Roadside	26.9	28.5	1.060
Rhondda Mountain Ash	Roadside	58.6	53.1	0.905
Swansea Station Court High Street	Roadside	38.5	51.7	1.344
Swansea Roadside	Roadside	23.9	30.4	1.270
Swansea Morriston Roadside	Roadside	27.7	29.7	1.075
Swansea Hafod DOAS	Roadside	38.4	44.1	1.150
Swansea St Thomas DOAS	Roadside	42.8	36.6	0.855
Swansea Cwm Level Park	Roadside	13.8	16.4	1.184
			Average Annualisation Factor	**1.126**
Survey Period 27/04/17 to 31/05/17 & 28/06/17 to 05/03/18 (9 months of data)				
Aston Hill	Rural	2.3	3.7	1.632

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Caerphilly White Street	Roadside	29.7	34.4	1.158
Caerphilly Blackwood High Street	Roadside	32.9	28.6	0.869
Hafod-yr-ynys Roadside	Kerbside	67.9	69.4	1.023
Nantgarw Road	Roadside	26.7	29.2	1.095
Cardiff Centre	Urban Centre	19.4	23.3	1.198
Chepstow A48	Roadside	33.6	34.8	1.034
Cwmbran	Urban background	12.0	12.9	1.081
V Glamorgan Windsor Road Penarth	Roadside	28.6	28.4	0.992
Newport M4 Junction 25	Roadside	43.5	45.8	1.054
Cimla Road / Victoria Gardens	Roadside	37.4	37.8	1.010
Port Talbot Margam	Urban Industrial	15.2	17.4	1.140
Rhondda-Cynon-Taf Broadway	Roadside	27.0	28.5	1.056
Rhondda Mountain Ash	Roadside	58.6	53.1	0.905
Swansea Station Court High Street	Roadside	33.4	51.7	1.548
Swansea Roadside	Roadside	24.1	30.4	1.260
Swansea Morriston Roadside	Roadside	25.7	29.7	1.155
Swansea Hafod DOAS	Roadside	37.1	44.1	1.188
Swansea St Thomas DOAS	Roadside	46.6	36.6	0.786
Swansea Cwm Level Park	Roadside	13.6	16.4	1.208
			Average Annualisation Factor	**1.139**

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Survey Period 07/03/17 to 27/04/17, 31/05/17 to 27/09/17, 02/11/17 to 06/12/17, 05/01/18 to 05/03/18 (9 months of data)				
Aston Hill	Rural	2.4	3.7	1.541
Caerphilly White Street	Roadside	29.7	34.4	1.159
Caerphilly Blackwood High Street	Roadside	30.9	28.6	0.925
Hafod-yr-ynys Roadside	Kerbside	68.1	69.4	1.019
Nantgarw Road	Roadside	25.6	29.2	1.142
Cardiff Centre	Urban Centre	19.5	23.3	1.195
Chepstow A48	Roadside	34.1	34.8	1.018
Cwmbran	Urban background	12.0	12.9	1.077
V Glamorgan Windsor Road Penarth	Roadside	29.3	28.4	0.968
Newport M4 Junction 25	Roadside	40.7	45.8	1.126
Cimla Road / Victoria Gardens	Roadside	36.5	37.8	1.036
Port Talbot Margam	Urban Industrial	15.4	17.4	1.128
Rhondda-Cynon-Taf Broadway	Roadside	26.9	28.5	1.060
Rhondda Mountain Ash	Roadside	58.6	53.1	0.905
Swansea Station Court High Street	Roadside	38.5	51.7	1.345
Swansea Roadside	Roadside	23.9	30.4	1.271
Swansea Morriston Roadside	Roadside	27.6	29.7	1.075
Swansea Hafod DOAS	Roadside	38.3	44.1	1.151
Swansea St Thomas DOAS	Roadside	42.8	36.6	0.856

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Swansea Cwm Level Park	Roadside	13.8	16.4	1.184
			Average Annualisation Factor	**1.129**
Survey Period 07/03/17 to 29/03/17, 31/05/17 to 28/06/17, 02/08/17 to 30/08/17 & 27/09/17 to 05/03/18 (8 months of data)				
Caerphilly White Street	Roadside	2.3	3.7	1.624
Caerphilly White Street	Roadside	30.8	34.4	1.119
Caerphilly Blackwood High Street	Roadside	35.0	28.6	0.816
Hafod-yr-ynys Roadside	Kerbside	69.4	69.4	1.000
Nantgarw Road	Roadside	28.7	29.2	1.017
Cardiff Centre	Urban Centre	20.9	23.3	1.112
Chepstow A48	Roadside	36.5	34.8	0.951
Cwmbran	Urban background	13.0	12.9	0.993
V Glamorgan Windsor Road Penarth	Roadside	29.7	28.4	0.954
Newport M4 Junction 25	Roadside	44.0	45.8	1.042
Cimla Road / Victoria Gardens	Roadside	39.6	37.8	0.956
Port Talbot Margam	Urban Industrial	16.4	17.4	1.060
Rhondda-Cynon-Taf Broadway	Roadside	28.4	28.5	1.004
Rhondda Mountain Ash	Roadside	60.3	53.1	0.880
Swansea Station Court High Street	Roadside	37.0	51.7	1.400
Swansea Roadside	Roadside	25.4	30.4	1.194
Swansea Morriston Roadside	Roadside	29.2	29.7	1.018

Table 14.3.6: Calculating an Annualisation Factor				
Monitoring Station[1]	Type	Period Mean	Annual Mean	Factor
Swansea Hafod DOAS	Roadside	39.1	44.1	1.128
Swansea St Thomas DOAS	Roadside	45.8	36.6	0.800
Swansea Cwm Level Park	Roadside	15.0	16.4	1.091
			Average Annualisation Factor	**1.075**

1.9.5 The analysis showed that the period mean concentration data gathered at the continuous monitoring stations in Wales were lower than the 2016 annual mean concentrations at the vast majority of locations for all periods considered. The average factors for each period were used to project the measured survey diffusion tube data into an annual mean concentration value to represent 2016.

1.9.6 Once projected to calendar year 2016 values, the survey diffusion tube measurement data was adjusted for diffusion tube bias. In the absence of a continuous NO_X monitoring station in the study area to allow a Project-specific co-location study, this was done using a diffusion tube bias adjustment factor made available by Defra (Ref 14.35). The adjustment factor was calculated based on co-location studies (comparing triplicate diffusion tube measurements gathered at the exact location of continuous NO_X monitoring stations) undertaken by a number of local authorities across the UK in 2017 (the year in which the bulk of the survey diffusion tubes were analysed), using the same provider and analyser of diffusion tubes and the same preparation and analysis methods as used for the Project-specific survey. The calculation of the diffusion tube bias adjustment factor is summarised in Table 14.3.7.

Table 14.3.7: Calculating a Diffusion Tube Bias Adjustment Factor				
Site Type	Local Authority	Concentration ($\mu g/m^3$)		Adjustment Factor
		Diffusion Tube	Monitoring Station	
UB	Bracknell Forest Borough Council	19	16	0.81

Table 14.3.7: Calculating a Diffusion Tube Bias Adjustment Factor				
Site Type	Local Authority	Concentration (µg/m^3)		Adjustment Factor
		Diffusion Tube	Monitoring Station	
R	Bracknell Forest Borough Council	47	39	0.82
R	Brighton & Hove City Council	51	50	0.98
R	Wokingham Borough Council	39	37	0.96
UC	Southampton City Council	31	29	0.95
R	Preston City Council	31	26	0.81
R	Monmouthshire County Council	42	33	0.79
R	Cheshire West and Chester	36	36	0.99
UI	Crawley Borough Council	28	28	1.01
R	Borough Council of King's Lynn & West Norfolk	29	25	0.86
R	Bath & North East Somerset	45	45	1.00
R	Nottingham City Council	38	41	1.07
R	Lancaster City Council	35	32	0.91
R	Thurrock Borough Council	54	52	0.97
R	Thurrock Borough Council	35	33	0.93
R	Thurrock Borough Council	33	29	0.87
UB	Thurrock Borough Council	30	28	0.93
R	Dudley Metropolitan Borough Council	50	50	0.99
UB	Dudley Metropolitan Borough Council	24	19	0.79
R	City of Lincoln Council	42	31	0.75
R	Gedling Borough Council	35	31	0.91
R	Gateshead Council	36	37	1.03
R	Gateshead Council	29	25	0.85
R	Gateshead Council	34	35	1.06
R	London Borough of Hounslow	65	54	0.82

Table 14.3.7: Calculating a Diffusion Tube Bias Adjustment Factor				
Site Type	Local Authority	Concentration (µg/m^3)		Adjustment Factor
		Diffusion Tube	Monitoring Station	
R	London Borough of Hounslow	59	53	0.90
B	London Borough of Hounslow	28	30	1.06
R	London Borough of Hounslow	43	34	0.78
B	London Borough of Hounslow	38	33	0.87
R	London Borough of Hounslow	52	42	0.80
UB	Liverpool City Council	20	17	0.87
R	North Ayrshire Council	26	21	0.81
R	South Gloucestershire Council	25	23	0.91
KS	Marylebone Road Inter-comparison	101	79	0.78
Average Diffusion Tube Bias Adjustment Factor				**0.89**

1.9.7 A summary of the annualisation (and diffusion tube bias adjustment) of the Project-specific survey data is provided in Table 14.3.8. The table demonstrates that at the majority of roadside locations, projected annual mean concentrations of NO_2 are well below the air quality objective values. However, the survey has also identified roadside locations where concentrations are in excess of the objective value. This is predicted to occur at locations adjacent to the A55 on Anglesey (A15) and in Gwynedd (G1), adjacent to parking laybys, at a location adjacent to the A5025 near Menai Bridge (A19), and at a location adjacent to the A487 on the approach to Bangor (G7).

Table 14.3.8: Annualised Project-Specific Survey Data				
Tube ID	Sample Period	Concentration (µg/m^3)		
		Period Mean	Annualised Mean	Bias Adjusted Annual Mean

Table 14.3.8: Annualised Project-Specific Survey Data				
Tube ID	Sample Period	Concentration (µg/m^3)		
		Period Mean	Annualised Mean	Bias Adjusted Annual Mean
A1	07/03/17 to 05/03/18	16.6	19.3	17.2
A2	07/03/17 to 29/03/17, 31/05/17 to 28/06/17, 02/08/17 to 30/08/17 & 27/09/17 to 05/03/18	7.0	7.6	6.7
A3	07/03/17 to 05/03/18	13.5	15.7	14.0
A4	07/03/17 to 05/03/18	4.9	5.7	5.1
A5	07/03/17 to 05/03/18	8.1	9.4	8.4
A6	07/03/17 to 05/03/18	17.9	20.8	18.5
A7	07/03/17 to 27/04/17, 31/05/17 to 27/09/17 & 02/11/17 to 05/03/18	14.8	17.0	15.1
A8	07/03/17 to 29/03/17, 31/05/17 to 28/06/17, 02/08/17 to 30/08/17 & 27/09/17 to 05/03/18	9.0	10.2	9.0
A9	27/04/17 to 31/05/17 & 28/06/17 to 05/03/18	6.3	7.2	6.4
A10	07/03/17 to 05/03/18	7.4	8.7	7.7
A11	07/03/17 to 31/05/17 & 28/06/17 to 05/03/18	15.6	17.8	15.8
A12	07/03/17 to 05/03/18	15.1	17.6	15.7
A13	07/03/17 to 05/03/18	17.6	20.4	18.2
A14	07/03/17 to 05/03/18	12.9	15.0	13.3
A15	07/03/17 to 05/03/18	42.2	49.1	**43.7**
A16	07/03/17 to 31/05/17 & 28/06/17 to 05/03/18	12.1	13.8	12.3
A17	07/03/17 to 02/08/17 & 30/08/17 to 05/03/18	16.0	18.1	16.1
A18	07/03/17 to 02/08/17, 30/08/17 to 27/09/17 & 02/11/17 to 05/03/18	19.0	21.4	19.0

Table 14.3.8: Annualised Project-Specific Survey Data				
Tube ID	Sample Period	Concentration (µg/m^3)		
		Period Mean	Annualised Mean	Bias Adjusted Annual Mean
A19	07/03/17 to 05/03/18	42.5	49.4	**44.0**
G1	07/03/17 to 05/03/18	67.9	79.0	**70.3**
G2	07/03/17 to 05/01/18	33.4	39.8	35.4
G3	07/03/17 to 05/03/18	25.0	29.1	25.9
G4	07/03/17 to 05/03/18	23.5	27.3	24.3
G5	07/03/17 to 05/03/18	10.0	11.6	10.4
G6	07/03/17 to 27/09/17 & 08/11/17 to 05/03/18	13.3	15.5	13.8
G7	07/03/17 to 02/011/17, 05/12/17 to 05/01/18 & 02/02/18 to 05/03/18	38.4	47.0	**41.9**
G8	07/03/17 to 02/08/17, 30/08/17 to 27/09/17 & 02/11/17 to 05/03/18	26.5	29.9	26.6
G9	07/03/17 to 05/03/18	12.6	14.6	13.0
G10	07/03/17 to 05/03/18	27.5	32.0	28.5
* It should be noted that measurements were taken at roadside locations and these concentrations are not necessarily representative of relevant human exposure. A15 and G1 are however considered by IACC and GC respectively to be at sensitive locations with regard to the hourly NO_2 objective.				

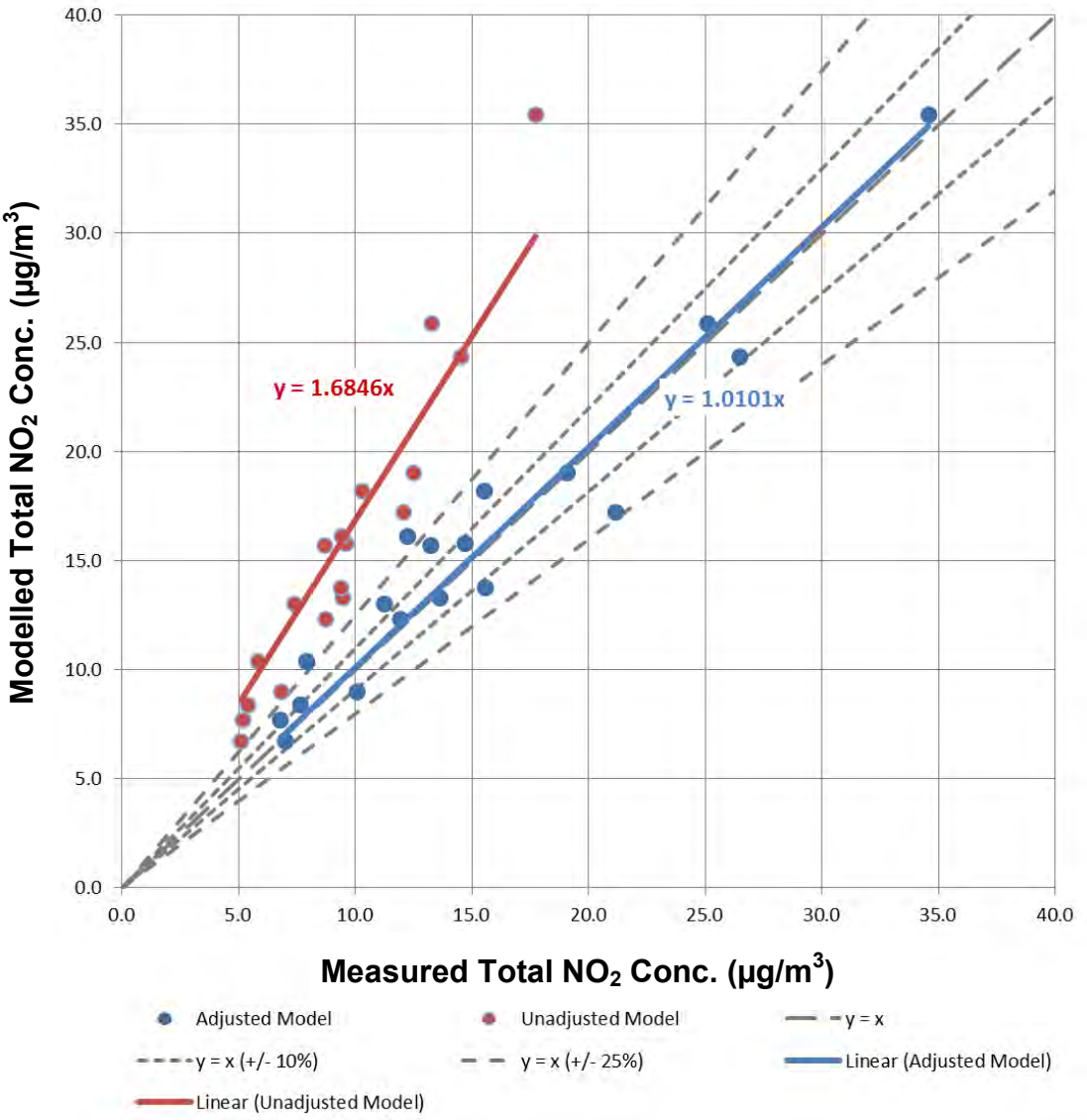
Verification

1.9.8 Annual mean NO_2 concentrations were predicted using the dispersion model at the same locations where the survey measurements were gathered, assuming 2016 vehicle emission rates and background pollutant concentrations, with 2016 meteorological data. The locations used were limited to the diffusion tubes that were sited adjacent to roads that would experience an increase in traffic flow as a result of the Proposed Development construction phase (i.e. roads for which Project traffic data was available). The measurements gathered at locations adjacent to some sections of the A55 were not included in the verification exercise (A15 and G1), because the measurements were influenced by HGVs idling and

accelerating at low speeds at layby locations, the emissions of which were not accounted for in the model. Furthermore, the measurement locations at the laybys are not representative of the relevant long-term exposure considered by the dispersion modelling. Diffusion tube A19 was also omitted from the verification exercise. Measurements at this location were consistently elevated for no identifiable reason and the model struggled to perform at this specific location. The A5025 adjacent to which diffusion tube A19 is located is not intended to be a main construction route.

1.9.9 Figure 14.3.2 shows that, the model under-predicted annual mean NO_2 concentrations by an average of 68% across the study area. Therefore, further analysis was undertaken to account for this model bias.

Figure 14.3.2 Comparison of Modelled and Measured NO_2 Concentrations



1.9.10 The next step requires the comparison of modelled and measured road NO_X contributions. Modelled road NO_X was taken directly from the dispersion model output and measured road NO_X was obtained by inputting the projected annual mean survey data into Defra's NO_X to NO_2 conversion tool (Ref 14.34).

1.9.11 NO_X factors were calculated for the model as a whole, and for the model split into geographic areas. The model-wide road NO_X factor was 2.4714. The calculated factors are provided in Table 14.3.9.

Table 14.3.9: Calculating Road NO_X Contribution Factors

Tube ID	Road NO_X Contribution ($\mu g/m^3$)			Modelled Area
	Modelled	Measured	Factor	
A1	13.5	23.4	1.7	Anglesey (A55/A5)
A2	2.4	5.3	2.2	Anglesey (elsewhere)
A5	8.4	7.0	2.9	Anglesey (elsewhere)
A8	8.2	6.0	1.9	Anglesey (elsewhere)
A10	6.6	5.0	3.2	Anglesey (elsewhere)
A11	19.0	15.7	2.6	Anglesey (A55/A5)
A12	19.7	16.5	3.1	Anglesey (A55/A5)
A13	22.5	19.4	3.0	Anglesey (A55/A5)
A14	13.0	10.1	2.2	Anglesey (A55/A5)
A16	4.2	10.7	2.6	Anglesey (elsewhere)
A17	3.9	16.4	4.2	Anglesey (A55/A5)
A18	9.6	22.1	2.3	Anglesey (A55/A5)
G2	18.7	56.2	3.0	Gwynedd (A55/A487)
G3	12.3	37.4	3.0	Gwynedd (A55/A487)
G4	12.6	32.0	2.5	Gwynedd (A55/A487)
G5	3.0	11.2	3.8	Gwynedd (elsewhere)
G6	9.2	17.4	1.9	Gwynedd (elsewhere)
G9	5.6	16.1	2.9	Gwynedd (elsewhere)
Road NO_X Contribution Factors				
			Model-wide	2.613
			Anglesey (A55/A5)	2.325

Table 14.3.9: Calculating Road NO_X Contribution Factors				
Tube ID	Road NO_X Contribution ($\mu g/m^3$)			Modelled Area
	Modelled	Measured	Factor	
Anglesey (elsewhere)				2.410
Gwynedd (A55/A487)				2.898
Gwynedd (elsewhere)				2.276

1.9.12 The factors calculated and summarised in Table 14.3.9 were applied to the modelled road NO_X contributions for the relevant collection of modelled diffusion tube locations. The adjusted modelled road NO_X was then converted to adjusted modelled total NO_2 concentrations using Defra's NO_X to NO_2 conversion tool (Ref 14.34). A comparison was then made of adjusted modelled total NO_2 and measured total NO_2 concentrations, which is shown in Figure 14.3.2. This comparison identified that the model performed marginally better after the use of the geographical road NO_X factors, rather than the model-wide factor. The figure shows that the adjusted model performs well, with predicted annual mean NO_2 concentrations now around 1% of measured values.

1.9.13 Further analysis of the adjusted model was undertaken by calculating the Root Mean Square Error (RMSE), Correlation Coefficient (CC) and Fractional Bias (FB) between the adjusted modelled and measured datasets. The results of this analysis are summarised in Table 14.3.10 and demonstrate that the adjusted model performs well with CC, RMSE and FB values within the ideal margins desired.

Table 14.3.10: Statistical Analysis of Adjusted Model				
Statistical Parameter	Formula	Purpose	Ideal Value	Adjusted Model Value
CC	$r=\left[\frac{\sum_{i=1}^{N}(Obs_i - Avg.Obs)(Pred_i - Avg.Pred)}{Stdev.Obs \times Stdev.Pred}\right]$	Quality of relationship between model and measurements	1.00 = Perfect relation-ship	0.97
RMSE	$RMSE=\sqrt{\frac{1}{N}\sum_{i=1}^{N}(Obs_i - Pred_i)^2}$	The level of uncertainty between model and	0 = no error. An RMSE of less than	1.91

Table 14.3.10: Statistical Analysis of Adjusted Model				
Statistical Parameter	Formula	Purpose	Ideal Value	Adjusted Model Value
		measurements	10% of the AQO (4.00) is considered the ideal	
FB	$FB = \frac{(Avg.Obs - Avg.Pred)}{0.5(Avg.Obs + Avg.Pred)}$	Level of systematic model under or over prediction against measurements	0 = no systematic under or over prediction	0.03

1.9.14 The model bias adjustment factors calculated were applied to modelled road NO_X contributions of each receptor considered in the assessment. The bias adjustment factor applied was dependent on the location of each receptor and which set of tubes were most representative of them.

1.9.15 In the absence of measured PM_{10} and $PM_{2.5}$ at roadside locations in the study area, the same factors calculated for the modelled road NO_X contribution were applied to the road PM_{10} and road $PM_{2.5}$ contributions.

1.10 PREDICTING THE NUMBER OF DAYS IN WHICH THE DAILY MEAN PM_{10} OBJECTIVE IS EXCEEDED

1.10.1 In order to assess model results against the Air Quality Strategy daily mean objective for PM_{10}, the guidance document LAQM.TG(03) (Ref 14.36) sets out the method by which the number of days in which the PM_{10} 24-hr objective is exceeded can be obtained based on a relationship with the predicted PM_{10} annual mean concentration.

1.10.2 The most recent Defra guidance suggests no change to this method. As such, the formula used within this assessment is below, where C denotes the annual mean concentration of PM_{10}:

$$\text{No. of } Exceedances = 0.0014 * C^3 + \frac{206}{C} - 18.5$$

1.11 PREDICTING THE NUMBER OF HOURS IN WHICH THE HOURLY MEAN NO_2 OBJECTIVE IS EXCEEDED

1.11.1 The assessment evaluates the likelihood of exceeding the hourly mean NO_2 objective by comparing predicted annual mean NO_2 concentrations at all receptors to an annual mean equivalent threshold of 60 $\mu g/m^3$ NO_2. The threshold of 60 $\mu g/m^3$ is derived from research projects which identified that the hourly mean NO_2 objective is unlikely to be exceeded if annual mean concentrations are predicted to be less the 60 $\mu g/m^3$ (Ref 14.40 & Ref 14.41).

1.11.2 Where predicted concentrations are below this value, it can be concluded that the hourly mean NO_2 objective (200 $\mu g/m^3$ NO_2 not more than 18 times per year) would most likely be achieved, particularly at locations that experience low background NO_2 levels.

5 Emergency Generator Emissions Modelling

1.12.1 The general model conditions used for this assessment are summarised in Table 14.3.11. Further model inputs are then described in more detail in the following paragraphs.

Table 14.3.11: ADMS 5 – General Model Conditions	
Variables	ADMS Roads Model Input
Surface roughness at source	0.5 m
Minimum Monin-Obukhov length for stable conditions	10 m
Terrain types	Flat
Receptor locations	X, Y coordinates determined by GIS, Z = 1.5 m
Sources	*n* diesel-fired generators
Source location	X, Y, Z
Emissions	NO_X, PM_{10}, $PM_{2.5}$, SO_2, CO
Emission Data	Based on supplier data
Meteorological data	5 years (2012 - 2016) hourly sequential data from Mona Meteorological Station
Emission profiles	100% load 24 hours per day
Receptors	Selected human sensitive and ecologically receptors
Model output	Long-term annual mean NO_X concentrations
	Short-term 24-hour mean NO_X concentrations
	Short-term 1-hour mean NO_X concentrations
	Long-term annual mean PM_{10} concentrations
	Short-term 24-hour mean PM_{10} concentrations
	Long-term annual mean $PM_{2.5}$ concentrations
	Long-term annual mean SO_2 concentrations

1.13 EMISSION PARAMETERS

1.13.1 The dispersion model ADMS 5 calculates the contribution of pollutants emitted from the emergency generator sources using the parameters summarised in Table 14.3.12. The values modelled for each parameter have been obtained from the data sheet for a Caterpillar 3516C diesel

generator (see Sub-Appendix 14.3.D). Whilst the actual generator to be used to generate power for the shaft and tunnel construction in the event of a failure to the primary power source is not confirmed at this stage, the amount of energy demand required is known. The Caterpillar 3516C generator is considered to be representative of the size of generator required to facilitate the shaft and tunnel construction.

1.13.2 For the assessment of emergency generator emissions, the assessment considers two TBM scenarios, one that assumes that the drive shaft would be sunk at Braint and the reception shaft would be sunk at Tŷ Fodol, and another that assumes the drive shaft would be sunk at Tŷ Fodol and the reception shaft sunk at Braint, and a drill and blast scenario.

1.13.3 For both TBM scenarios and the drill and blast scenario, the tunnelling works would require an energy demand of 12 MVA. For TBM, the sinking of the drive shaft and construction of the tunnel would require an energy demand of 9 MVA, and the sinking of the reception shaft would require a demand of 3 MVA. This equates to 7.2 MW and 2.4 MW respectively. In the event of an emergency, this power demand can be met by six Caterpillar 3516C generators at the drive shaft tunnel head house site, operating continuously at 70% load, and two Caterpillar 3516C generators operating continuously at 80% load at the reception shaft tunnel head house site.

Table 14.3.12: Emergency Generator Emissions Parameters

Parameter	Drive Shaft		Reception Shaft	
	From Braint	From Tŷ Fodol	From Tŷ Fodol	From Braint
Source ID and Location (x,y)	A1 - 251694, 371029	G1 - 254571, 368409	A1 - 251694, 371029	G1 - 254571, 368409
	A2 - 251691. 371030	G2 - 254573, 368407		
	A3 - 251689, 371031	G3 - 254575, 368404		
	A4 - 251687, 371032	G4 - 254578, 368402	A2 - 251691, 371030	G2 - 254573, 368407
	A5 - 251684, 371034	G5 - 254580, 368400		
	A6 - 251682, 371035	G6 - 254582, 368398		

Table 14.3.12: Emergency Generator Emissions Parameters				
Parameter	Drive Shaft		Reception Shaft	
	From Braint	From Tŷ Fodol	From Tŷ Fodol	From Braint
Stack/Exhaust Exit height (m)	2		2	
Stack/Exhaust Exit Diameter (m)	0.3		0.3	
Gas Exit Temperature (ºC)	353.1		361.9	
Mass Gas Volume Flow (kg/s)	3.098		3.269	
NO_X Emission Rate (g/s)	2.441			
PM_{10} (and assumed $PM_{2.5}$) Emission Rate (g/s)	0.028			
SO_2 Emission Rate (g/s)	0.00000012			

1.14 MODELLED SCENARIOS

1.14.1 The quantification of emergency generator emissions to annual mean pollutant concentrations has assumed that all eight generators could be operational for up to 500 hours per year (5.7% of the year). This is made up of 52 hours of testing and 448 hours of emergency operation per generator, per year. The assumed 448 hours of emergency operation is considered to be a robust estimate of the number of hours in which the primary power source could be out of operation.

1.14.2 The modelled contribution of emergency generator emissions to annual mean concentrations has been added to the contribution of construction vehicle emissions to estimate combined impacts at receptors located near to Construction Traffic Routes and the Braint and Tŷ Fodol Construction Compounds.

1.14.3 The quantification of emergency generator emissions to short-term pollutant concentrations (including daily mean PM_{10} and NO_X, and hourly

mean NO_2) has assumed that generator testing and/or emergency operation could occur over any hourly or daily period in a year. This is considered to represent a robust estimate of short-term impacts, in that it assumes the operation of the emergency generators would coincide with the worst meteorological conditions at each sensitive receptor considered (i.e. the worst 24-hour period of meteorological conditions at each ecological site considered for daily mean NO_X, the 35 worst 24-hour periods of meteorological conditions for daily mean PM_{10} and the 18 worst meteorological hours for hourly mean NO_2). In reality, each emergency generator would be operational for just 52 hours per year for testing, and a limited number of hours when the primary power source is down. Assuming 500 hours of operation in total, this would account for 5.7% of the year, so it is unlikely that it would coincide with the worst-case meteorological conditions set out above. It is also considered unlikely that the emergency generators would be in operation for a consecutive period of more than 24 hours.

1.15 BACKGROUND POLLUTANT CONCENTRATIONS

1.15.1 The background pollutant concentration data for annual mean concentrations of NO_2 and PM_{10} at receptors considered for emergency generator emissions are listed in Table 14.3.13. Background pollutant concentrations for annual mean NO_X and annual mean nutrient nitrogen deposition and acid as nitrogen deposition rates are listed in Table 14.3.14.

1.15.2 The background pollutant concentration data for hourly mean NO_2 concentrations and daily mean PM_{10} concentrations for the 1 km by 1 km grid square within which the human health sensitive receptors are located is provided in Table 14.3.4. The background pollutant concentration data for daily mean NO_X concentrations is provided in Table 14.3.5. In line with guidance and advice from the Environment Agency (EA) (which is applicable in Wales), the hourly mean NO_2 background concentration is derived by doubling the annual mean background concentration. The daily mean PM_{10} and NO_X background concentrations are derived by multiplying the annual mean background concentration by 1.5.

Table 14.3.13: Background Pollutant Concentration Data – Human Health Sensitive Receptors

Receptor ID	Modelled Grid Reference		Hourly Mean NO_2 Concentrations ($\mu g/m^3$)	Daily Mean PM_{10} Concentrations ($\mu g/m^3$)
	X	Y		
Section E – Ceint to the Afon Braint				

Table 14.3.13: Background Pollutant Concentration Data – Human Health Sensitive Receptors				
Receptor ID	Modelled Grid Reference		Hourly Mean NO_2 Concentrations ($\mu g/m^3$)	Daily Mean PM_{10} Concentrations ($\mu g/m^3$)
	X	Y		
R5/02917	251806	371947	12.5	14.3
R5/02725	251064	371379	12.5	14.3
R5/02641	250640	371023	10.2	14.3
R5/02815	251334	370703	8.3	13.0
Section F Afon Braint to Pentir (IACC section)				
R5/03460	252270	371693	12.9	15.7
R5/02987	251914	371174	12.5	14.3
R5/03425	252216	371121	12.9	15.7
R5/03755	252432	370927	8.6	13.3
R5/02878	251642	370384	8.3	13.0
Section F Afon Braint to Pentir (Gwynedd Council section)				
R5/07577	254915	368854	9.9	13.4
R5/07156	254409	368565	9.9	13.4
R5/07079	254311	368487	9.9	13.4
R5/07647	254972	368402	9.9	13.4
R5/06868	253923	368365	9.3	13.4
R5/08346	255257	368362	9.1	13.3
R5/07524	254887	368025	9.9	13.4
R5/07322	254757	368001	9.9	13.4
R5/08574	255296	367998	8.4	13.2
R5/07236	254614	367869	8.3	13.4
R5/06922	254033	367777	8.3	13.4

Table 14.3.14: Background Pollutant Concentration Data – Ecologically Sensitive Receptors					
Receptor ID	Ecological Receptor	Modelled Grid Reference		Annual Mean SO_2 Conc. ($\mu g/m^3$)	Daily Mean NO_X Conc. ($\mu g/m^3$)
		X	Y		
Section C – Llandyfrydog to B5110 North of Talwrn					
AQ/C/E02	Corsydd Mon SAC at Llanddyfnan (west)	249926	378760	9.3	0.9
AQ/C/E03	Corsydd Mon SAC at Llanddyfnan (east)	251059	378510	9.5	0.9
Section D – B5110 North of Talwrn to Ceint					
AQ/D/E01	Corsydd Mon SAC (north of Talwrn)	248995	377636	10.5	1.0
AQ/D/E02	Corsydd Mon SAC (west of Talwrn)	247744	376979	9.9	1.0
AQ/D/E03	Corsydd Mon SAC (east of Talwrn)	249836	376854	9.9	1.0
AQ/D/E04	Cors Ddyga SSSI	245325	373513	13.6	1.3
Section F Afon Braint to Pentir (IACC section)					
AQ/F(A)/E01	Ancient Semi Natural Woodland (Ref: 25877)	251103	370394	10.7	1.0
AQ/F(A)/E02	Restored Ancient Woodland Site (Ref: 24261)	252206	370542	11.0	1.0
AQ/F(A)/E03	Plantation on Ancient Woodland Site (Ref: 43628)	251550	370369	10.7	1.0
Section F Afon Braint to Pentir (Gwynedd Council section)					
AQ/F(G)/E01	Coedydd Afon Menai SSSI (northeast of A55)	254259	370888	17.6	1.0
AQ/F(G)/E02	Coedydd Afon Menai SSSI (southwest of A55)	254146	370850	17.6	1.0
AQ/F(G)/E03	Plantation on Ancient	254260	368700	12.3	1.2

Table 14.3.14: Background Pollutant Concentration Data – Ecologically Sensitive Receptors					
Receptor ID	Ecological Receptor	Modelled Grid Reference		Annual Mean SO_2 Conc. ($\mu g/m^3$)	Daily Mean NO_X Conc. ($\mu g/m^3$)
		X	Y		
	Woodland Site (Ref: 43562)				
AQ/F(G)/E04	Ancient Semi Natural Woodland (Ref: 25071)	253724	368549	11.6	1.2
AQ/F(G)/E05	Plantation on Ancient Woodland Site (Ref: 43561)	254306	368426	12.3	1.2
AQ/F(G)/E06	Ancient Woodland Site of Unknown Category (Ref: 48976)	254580	368248	12.3	1.2
AQ/F(G)/E07	Plantation on Ancient Woodland Site (Ref: 43552)	254340	368195	12.3	1.2
AQ/F(G)/E08	Plantation on Ancient Woodland Site (Ref: 43538)	255673	368125	11.6	1.2
AQ/F(G)/E09	Plantation on Ancient Woodland Site (Ref: 43537)	255568	367878	10.7	1.2
AQ/F(G)/E10	Plantation on Ancient Woodland Site (Ref: 43555)	254534	367580	10.5	1.2
AQ/F(G)/E11	Eryri SAC	263433	370150	10.4	1.0
AQ/F(G)/E12	Eryri SAC	262648	367915	10.8	1.6
AQ/F(G)/E13	Eryri SAC	258657	366517	9.9	1.2
AQ/F(G)/E14	Eryri SAC	257686	364888	10.1	2.0
AQ/F(G)/E15	Eryri SAC	258930	362376	9.8	2.0

1.16 NO_X TO NO_2 CONVERSION

1.16.1 The contribution to annual mean concentrations of NO_2 from the emergency generator emissions is derived from the modelled NO_X output, assuming that 70% of NO_X emissions are emitted as or converted to NO_2 as the plume disperses.

1.16.2 The contribution of hourly mean concentrations of NO_2 from the emergency generator assumes that 35% of total hourly NO_X emissions are emitted as or converted to NO_2 as the plume disperses.

1.16.3 This approach is recommended by the Environment Agency (Ref 14.19).

1.17 SPECIAL MODEL TREATMENT

Building Downwash

1.17.1 Whilst the Braint and Tŷ Fodol Construction Compounds would contain some single storey buildings and structures, the nearest air quality sensitive receptors are located far enough away from the emergency generator exhausts such that the presence and height of those building and structures would be unlikely to influence the concentrations predicted.

Terrain

1.17.2 The terrain in the vicinity of the Braint and Tŷ Fodol Construction Compounds is variable, due to the size of the area covered. However, there are no major gradients or pronounced changes in height between the stacks/exhausts and the nearest air quality sensitive receptors. For this reason, flat terrain has been assumed within the modelling assessment.

1.17.3 Sub-Appendix 14.3.E provides a sensitivity analysis of modelling dispersion from emergency generator emissions with the influence of terrain.

1.18 PREDICTING THE LIKELIHOOD OF EXCEEDING THE HOURLY MEAN NO_2 AIR QUALITY OBJECTIVE

1.18.1 To consider the impact on short term NO_2 concentrations from emergency generator operation, the assessment has considered the approach set out in the Environment Agency's Briefing Note: Diesel Generator Short Term NO_2 Impact Assessment (Ref 14.26).

1.18.2 The Air Quality Modelling & Assessment Unit (AQMAU) of the Environmental Agency completed an assessment of short-term NO_2 impacts associated with diesel generator operation. The report described a

statistical methodology for assessing air quality impacts (with a focus on NO_2) for sites with multiple generator sets where the frequency and timing of operation is uncertain. It describes how a hypergeometric distribution can be used to randomly select multiple hours within a year (each with specific meteorological data) and predict the probability of an exceedance of the relevant air quality standard based on the number of random hours selected. A probability of less than 5% (i.e. a one in 20-year event) can be used as an indicator for "unlikely exceedances". This distribution analysis has been completed for the operation of the emergency generator plant at the Braint and Tŷ Fodol Construction Compounds.

1.18.3 This analysis identified that at the receptor most likely to be affected by short-term emergency generator emissions (R5/02987), the continuous operation of all emergency generators for a full year would not cause an exceedance of the hourly mean NO_2 air quality objective value.

Sub-Appendix A – Meteorological Data Sensitivity Analysis

1.19 INTRODUCTION

1.19.1 The dispersion model of emergency generator emissions was modelled using five years of hourly sequential meteorological data from the station at Mona on Anglesey.

1.20 RESULTS

1.20.1 The results of the meteorological data sensitivity analysis are provided in Table 14.3.15 and Table 14.3.16. The analysis focuses on predicted annual mean and hourly mean concentrations of NO_X (without any adjustment), at the two receptors nearest to the Braint and Tŷ Fodol Construction Compounds, assuming continuous of operation.

1.20.2 The tables demonstrate that there is limited variation in modelled predictions at those receptors as a result of differing meteorological data, with the majority of predictions being within 10% of the maximum value.

Table 14.3.15: Analysis of Meteorological Data Sensitivity – TBM from Braint

Receptor ID	Modelled Grid Reference		NO_X Concentration (µg/m^3)				
	X	Y	2012	2013	2014	2015	2016
Annual Mean							
R5/02987	251881	371162	64.6	59.0	67.0	62.3	65.6
R5/07577	254915	368854	6.7	6.2	6.7	6.9	6.9
Hourly Mean							
R5/02987	251881	371162	136.0	136.0	135.0	132.0	136.0
R5/07156	254409	368565	128.1	127.0	127.0	127.0	126.0

Table 14.3.16: Analysis of Meteorological Data Sensitivity – TBM from Tŷ Fodol							
Receptor ID	Modelled Grid Reference		NO_X Concentration (µg/m^3)				
	X	Y	2012	2013	2014	2015	2016
Annual Mean							
R5/02987	251881	371162	21.8	20.0	22.8	21.3	22.2
R5/07577	254915	368854	19.3	18.0	19.2	20.0	19.8
Hourly Mean							
R5/02987	251881	371162	135.0	135.0	135.0	132.0	135.0
R5/07156	254409	368565	128.0	127.0	127.0	127.0	126.0

Sub-Appendix B – Traffic Data

Table 14.3.16: Annual Average 24 Hour Traffic Flow Data

Link Ref.	Description	2016 Baseline		2023 Baseline		2023 Construction (TBM)		2023 Construction (D&B)		Average Speed (mph)[1]
		AADT	HDV	AADT	HDV	AADT	HDV	AADT	HDV	
1	A5025 between A5 at Valley Crossroads and Wylfa	2483	165	2652	176	2739	215	2739	215	54
2	A5 between A55 J3 and Valley Crossroads	7001	411	7480	439	7567	479	7567	479	42
3	Unnamed Road (UNR)4 between B5111 and access B2	757	58	809	62	828	75	828	75	53
4	B5111 between B5110 and Llanerchymedd	3073	133	3283	142	3354	191	3354	191	54
4.1	B5111 between Llanerchymedd access B8	3375	181	3606	194	3677	243	3677	243	37
5	B5110 between B5111 and access C8	2534	136	2707	145	2749	176	2749	176	43
6	B5420/B5109/Ffordd Cae Sel between Llangefni Link Road (LLR) and B5111	9006	354	9622	378	9745	465	9745	465	30

Table 14.3.16: Annual Average 24 Hour Traffic Flow Data

Link Ref.	Description	2016 Baseline		2023 Baseline		2023 Construction (TBM)		2023 Construction (D&B)		Average Speed (mph)[1]
		AADT	HDV	AADT	HDV	AADT	HDV	AADT	HDV	
7	B5420 between LLR and access D4	1979	78	2115	83	2153	100	2153	100	53
7.1	B5420 between access D4 and Four Crosses Roundabout	1979	78	2115	83	2153	100	2153	100	53
8	A5114 between A55 J6 LLR	13517	735	14441	785	14588	888	14588	888	47
8.1	Industrial estate road between A5114 via existing carriageway to LLR	6285	269	6715	287	6862	391	6862	391	30
8.2	LLR between A5114 and the B5420	6367	318	6802	340	6802	340	6802	340	30
9	A5025 between A55 J8 and Four Crosses Roundabout	11220	522	11987	557	12025	574	12025	574	48
11	UNR between Star and access E5	624	28	667	29	682	40	682	40	27
11.1	UNR between Star Crossroads and UNR Star	624	28	667	29	682	40	682	40	27
12	A5152 between A55 J7 and the A5	4843	446	5174	476	5310	534	5337	554	30
13	A5 between A5152 and A55 J7A	4297	233	4591	249	4726	307	4753	327	58
14	National Cycle Route (NCR) 8/Llanddaniel Road between A5 and access E7	1048	76	1120	81	1249	133	1279	156	48

Table 14.3.16: Annual Average 24 Hour Traffic Flow Data

Link Ref.	Description	2016 Baseline		2023 Baseline		2023 Construction (TBM)		2023 Construction (D&B)		Average Speed (mph)[1]
		AADT	HDV	AADT	HDV	AADT	HDV	AADT	HDV	
15	Pont Rhonwy Link between the A5 and access F1	440	20	470	21	600	73	630	96	34
16	A4080 between the A5 at Tollgate and F2	4270	141	4562	150	4691	203	4721	226	45
17	A5 between A55 J8A and A4080	9158	409	9785	437	9914	489	9944	512	38
18	A487 between B4547 and A55 J9	17626	1142	19063	1235	19278	1337	19262	1326	49
18.1	A4087 between A55 J10 and A487	10640	323	11507	349	11615	400	11607	395	60
19	B4547 between A4244 and A487	5687	200	6151	216	6366	318	6350	307	56
20	A4244 between A5 and B4547	7547	495	8162	535	8377	637	8361	626	54
21	A55 Britannia Bridge between A55 J9 and A55 J8A	29894	1696	32330	1834	32620	1993	32625	1991	70
22	B5109 between LLR and access D2	1644	68	1756	72	1767	72	1767	72	50
23	A5025/Ffordd y Felin between Wylfa Access and Brynddu Road	1020	34	1090	37	1102	37	1102	37	32
24	B5110 between access C8 and UNR19	2534	136	2707	145	2728	145	2728	145	43
25	Brynddu Road between Fordd y Felin and access B2	388	19	415	21	427	21	427	21	41

Table 14.3.16: Annual Average 24 Hour Traffic Flow Data

Link Ref.	Description	2016 Baseline		2023 Baseline		2023 Construction (TBM)		2023 Construction (D&B)		Average Speed (mph)[1]
		AADT	HDV	AADT	HDV	AADT	HDV	AADT	HDV	
26	B5112 between A55 J5 and B5111	1217	57	1300	61	1336	61	1336	61	47
27	UNR1 between Brynddu Road and UNR4	81	0	86	0	98	0	98	0	30
28	UNR8 between B5111 and access B11	473	0	505	0	541	0	541	0	30
29	UNR9 between B5111 UNR10	601	50	642	53	678	53	678	53	38
30	Fodolydd Lane between B4547 and access F3	37	0	40	0	115	0	115	0	39
31	UNR10 between B5111 and UNR9	712	44	761	47	796	47	796	47	48
32	UNR16 between B5420 and access E1	423	28	452	30	459	30	459	30	42
33	UNR19 between B5110 and access C6	80	0	86	0	96	0	96	0	31
34	Fodolydd Lane between B4547 and access F4 (enabling works only)	46	0	50	0	50	0	50	0	31
35	UNR3 between Brynddu Road and access A9	85	0	91	0	103	0	103	0	37
36	UNR3 between Brynddu Road and access A10	127	9	136	9	151	19	151	19	39
	B5420 from Menai Bridge	11456	500	12239	535	12239	535	12239	535	30

Table 14.3.16: Annual Average 24 Hour Traffic Flow Data

Link Ref.	Description	2016 Baseline		2023 Baseline		2023 Construction (TBM)		2023 Construction (D&B)		Average Speed (mph)[1]
		AADT	HDV	AADT	HDV	AADT	HDV	AADT	HDV	
	A5025 Four Crosses east from Benllech	12585	465	13446	497	13446	497	13446	497	40
	A487 Ffordd Treborth	10643	303	11511	328	11511	328	11511	328	40
	A55 J9 Eastbound Off-slip	8895	323	9620	349	9728	400	9720	395	50
	A55 J9 Eastbound On-slip	6012	224	6502	242	6610	293	6602	288	50
	A55 J9 Tafarn Newydd Link	9009	165	9743	178	9743	178	9743	178	40
	B4366	6833	470	7390	509	7390	509	7390	509	40
	A4244 towards Llanberis	8389	251	9072	272	9072	272	9072	272	40
	A55 J8 Eastbound Off-slip	5011	278	5354	297	5354	297	5354	297	50
	A55 J8 Eastbound On-slip	4011	223	4285	238	4304	246	4304	246	50
	A55 J8 Westbound Off-slip	4678	260	4998	277	5017	286	5017	286	50
	A55 J8 Westbound On-slip	3600	200	3846	213	3846	213	3846	213	50
	A55 J7 Eastbound On-slip	2927	146	3127	156	3200	208	3200	208	50
	A55 J7 Eastbound Off-slip	4278	214	4570	229	4570	229	4570	229	50
	A55 J7 Westbound On-slip	2132	107	2278	114	2278	114	2278	114	50
	A55 J7 Westbound Off-slip	4534	227	4845	242	4918	294	4918	294	50
	A5025 Station Road Valley	3589	238	3834	254	3834	254	3834	254	30

Table 14.3.16: Annual Average 24 Hour Traffic Flow Data

Link Ref.	Description	2016 Baseline		2023 Baseline		2023 Construction (TBM)		2023 Construction (D&B)		Average Speed (mph)[1]
		AADT	HDV	AADT	HDV	AADT	HDV	AADT	HDV	
	A5 Holyhead Road Valley West	6767	350	7230	374	7230	374	7230	374	30
	A55 between J8A and J8	25130	1739	26849	1858	27140	2017	27144	2014	70
	A55 between J8 and J7A	18793	1396	20078	1492	20369	1651	20373	1648	70
	A55 between J7a and J7	20530	1341	21934	1433	22224	1592	22229	1589	70
	A55 between J7 and J6	18166	880	19409	940	19555	1044	19555	1044	70
	A55 between J6 and J5	12942	631	13827	674	13914	713	13914	713	70
	A55 between J5 and J4	13955	886	14909	947	14996	986	14996	986	70
	A55 between J4 and J3	14194	821	15165	877	15252	916	15252	916	70
	A55 between J9 and J10	26260	1496	28400	1618	28690	1777	28695	1775	70
	A55 between J10 and J11	27134	1955	29346	2115	29636	2274	29640	2271	70
	A55 East of J11	28099	1767	30389	1911	30604	2013	30588	2002	70

[1] Speed data given as provided from the traffic surveys undertaken for the assessment. Where speed data is not available, professional judgement has been used to estimate average speed, based on the speed limit of the link. Speeds have been reduced on the approach to junctions. The speed limit assumed for the Access Tracks was 10 mph.

Sub-Appendix C – NO_2 Diffusion Tube Analysis

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ilac-MRA UKAS TESTING 2187

LABORATORY ANALYSIS REPORT

COLORIMETRIC ANALYSIS OF NITROGEN DIOXIDE DIFFUSION TUBES

REPORT NUMBER L02499R
BOOKING IN REFERENCE L02499
DESPATCH NOTE 35332
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 03/04/2017

Location	Sample Number	Exposure Data		Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
		Date On	Date Off				
G9	874742	06/03/2017	29/03/2017	551.08	14.06	7.34	0.56
G6	874743	07/03/2017	29/03/2017	527.17	13.52	7.06	0.52
G5	874744	07/03/2017	29/03/2017	527.25	10.02	5.23	0.38
G3	874745	06/03/2017	29/03/2017	553.83	27.53	14.37	1.11
G4	874746	07/03/2017	29/03/2017	528.25	26.38	13.77	1.01
G7	874747	06/03/2017	29/03/2017	553.87	42.73	22.30	1.72
A16	874748	06/03/2017	29/03/2017	548.08	12.48	6.51	0.50
A17	874749	06/03/2017	29/03/2017	552.83	16.35	8.53	0.66
A18	874750	07/03/2017	29/03/2017	528.67	20.66	10.79	0.79
A19	874751	07/03/2017	29/03/2017	528.67	36.75	19.18	1.41
G10	874752	06/03/2017	29/03/2017	555.00	35.48	18.52	1.43
G8	874754	06/03/2017	29/03/2017	555.17	31.95	16.67	1.29
G2	874753	06/03/2017	29/03/2017	549.58	36.23	18.91	1.45
A14	874756	06/03/2017	29/03/2017	549.42	15.13	7.89	0.60
A13	874755	06/03/2017	29/03/2017	549.33	20.26	10.58	0.81
A12	874757	06/03/2017	29/03/2017	549.58	15.87	8.28	0.63
A11	874762	06/03/2017	29/03/2017	549.33	13.68	7.14	0.55
A1	874758	07/03/2017	29/03/2017	533.67	15.78	8.24	0.61
A2	874763	07/03/2017	29/03/2017	533.57	6.99	3.65	0.27
A6	874764	07/03/2017	29/03/2017	533.17	19.92	10.40	0.77
A7	874765	07/03/2017	29/03/2017	533.42	14.70	7.67	0.57
A8	874766	07/03/2017	29/03/2017	532.83	8.37	4.37	0.32
A10	874759	07/03/2017	29/03/2017	532.75	6.82	3.56	0.26
A5	874772	07/03/2017	29/03/2017	533.33	4.95	2.59	0.19
A4	874767	07/03/2017	29/03/2017	534.83	9.18	4.79	0.36
A3	874768	07/03/2017	29/03/2017	535.33	14.98	7.82	0.58

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

gradko environmental
(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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A15	874773	07/03/2017	30/03/2017	546.33	47.02	24.54	1.87
G1	874774	06/03/2017	30/03/2017	576.25	81.78	42.68	3.43
Travel Blank	888595			576.25	0.02	0.01	0.00
Laboratory Blank				576.25	0.05	0.02	0.002

Comment: Results are not blank subtracted

Results have been corrected to a temperature of 293 K (20 °C)

Travel blank received with sample set L02500 and reported on both reports.

Overall M.U. ±5.1% **Limit of Detection** 0.020µg NO_2

Tube Preparation: 20% TEA /Water

Analyst Name Eva Habjan **Report Checked By** Duncan Wilson

Date of Analysis 18/04/2017 **Date of Report** 18/04/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM9 - QuAAtro Analyser

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

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LABORATORY ANALYSIS REPORT

COLORIMETRIC ANALYSIS OF NITROGEN DIOXIDE DIFFUSION TUBES

REPORT NUMBER L03422R
BOOKING IN REFERENCE L03422
DESPATCH NOTE 35336
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 09/05/2017

Location	Sample Number	Exposure Data		Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
		Date On	Date Off				
G5_B4547	903182	29/03/2017	27/04/2017	693.83	12.45	6.50	0.63
G6_TYMAWR	903183	29/03/2017	27/04/2017	694.00	16.20	8.45	0.82
G7_BANGOR	903184	29/03/2017	27/04/2017	693.08	43.08	22.48	2.17
G8_BANGOR	903185	29/03/2017	27/04/2017	691.67	27.09	14.14	1.36
G9_PENTIR	903186	29/03/2017	27/04/2017	694.17	14.65	7.64	0.74
G10_BANGOR	903187	29/03/2017	27/04/2017	691.75	29.58	15.44	1.49
A1_VALLEY	903161	29/03/2017	27/04/2017	688.42	21.65	11.30	1.08
A3_LLANERCHYMEDD	903162	29/03/2017	27/04/2017	686.58	14.85	7.75	0.74
A4_CAPELCOCH	903163	29/03/2017	27/04/2017	687.00	4.51	2.35	0.23
A5_RHOSMEIRCH	903164	29/03/2017	27/04/2017	687.33	7.89	4.12	0.39
A6_LLANGEFNI	903165	29/03/2017	27/04/2017	688.33	19.39	10.12	0.97
A7_LLANGEFNI	903166	29/03/2017	27/04/2017	688.17	14.50	7.57	0.73
A8_LLANGEFNI	903167	29/03/2017	27/04/2017	688.42	7.20	3.76	0.36
A10_CEINT	903168	29/03/2017	27/04/2017	688.42	6.64	3.46	0.33
A11_FFORD CAERGYBI	903169	29/03/2017	27/04/2017	688.58	19.28	10.06	0.97
A12_STAR	903170	29/03/2017	27/04/2017	688.50	18.25	9.52	0.91
A13_STAR	903180	29/03/2017	27/04/2017	688.75	16.94	8.84	0.85
A14_STAR	903179	29/03/2017	27/04/2017	688.67	17.40	9.08	0.87
A15_LLANFAIR	903178	29/03/2017	27/04/2017	698.25	47.90	25.00	2.43
A16_LLANFAIR	903177	29/03/2017	27/04/2017	690.08	14.65	7.65	0.74
A17_LLANFAIR	903176	29/03/2017	27/04/2017	690.00	17.53	9.15	0.88
A18_LLANFAIR	903175	29/03/2017	27/04/2017	689.50	20.55	10.73	1.03
A19_MENAI	903174	29/03/2017	27/04/2017	691.75	49.43	25.80	2.49
G1_A55 WESTBOUND	903173	29/03/2017	27/04/2017	695.83	37.51	19.58	1.90
G2_A55 EASTBOUND	903172	29/03/2017	27/04/2017	691.08	98.89	51.61	4.97
G3_CAPEL-Y-GRAIG	903171	29/03/2017	27/04/2017	693.67	21.98	11.47	1.11
G4_TREBORTH	903181	29/03/2017	27/04/2017	693.08	24.24	12.65	1.22

REPORT OFFICIALLY CHECKED

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Signed.....
L. Gates, Laboratory Manager

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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Laboratory Blank	698.25	0.20	0.10	0.010

Comment: Results are not blank subtracted

Results have been corrected to a temperature of 293 K (20 °C)

Overall M.U. ±5.1% **Limit of Detection** 0.020µg NO_2

Tube Preparation: 20% TEA /Water

Analyst Name Joanna Kowalewska **Report Checked By** Duncan Wilson

Date of Analysis 24/05/2017 **Date of Report** 24/05/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM9 - QuAAtro Analyser

REPORT OFFICIALLY CHECKED

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L. Gates, Laboratory Manager

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LABORATORY ANALYSIS REPORT

COLORIMETRIC ANALYSIS OF NITROGEN DIOXIDE DIFFUSION TUBES

REPORT NUMBER L04117R
BOOKING IN REFERENCE L04117
DESPATCH NOTE 35341
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 07/06/2017

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
G9	904145	27/04/2017	31/05/2017	816.75	12.92	6.74	0.77
G6	904144	27/04/2017	31/05/2017	816.00	16.56	8.64	0.98
G5	904143	27/04/2017	31/05/2017	817.08	10.19	5.32	0.61
G3	904142	27/04/2017	31/05/2017	817.33	25.64	13.38	1.52
G4	904141	27/04/2017	31/05/2017	817.92	21.13	11.03	1.26
G7	904140	27/04/2017	31/05/2017	817.92	39.35	20.54	2.34
G2	904138	27/04/2017	31/05/2017	818.50	40.75	21.27	2.42
A14	904137	27/04/2017	31/05/2017	820.75	13.95	7.28	0.83
A13	904136	27/04/2017	31/05/2017	820.75	13.81	7.21	0.82
A12	904155	27/04/2017	31/05/2017	821.00	15.49	8.08	0.92
A11	904154	27/04/2017	31/05/2017	820.92	18.60	9.71	1.11
A1	904153	27/04/2017	31/05/2017	821.08	16.29	8.50	0.97
A6	904147	27/04/2017	31/05/2017	821.75	16.22	8.47	0.97
A10	904148	27/04/2017	31/05/2017	820.75	6.55	3.42	0.39
A9	904149	27/04/2017	31/05/2017	820.75	6.49	3.39	0.39
A5	904150	27/04/2017	31/05/2017	821.08	7.76	4.05	0.46
A4	904151	27/04/2017	31/05/2017	821.17	4.93	2.57	0.29
A3	904152	27/04/2017	31/05/2017	821.08	15.65	8.17	0.93
A15	904158	27/04/2017	31/05/2017	821.58	46.98	24.52	2.81
G1	904146	27/04/2017	31/05/2017	824.02	77.48	40.44	4.64
A16	904157	27/04/2017	31/05/2017	824.17	11.04	5.76	0.66
A17	904156	27/04/2017	31/05/2017	824.50	14.89	7.77	0.89
A18	874800	27/04/2017	31/05/2017	824.83	19.70	10.28	1.18
A19	874798	27/04/2017	31/05/2017	822.58	42.57	22.22	2.55
G10	874799	27/04/2017	31/05/2017	822.42	28.09	14.66	1.68
G8	874788	27/04/2017	31/05/2017	822.17	28.78	15.02	1.72
Laboratory Blank				824.83	0.10	0.05	0.006

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Comment: Results are not blank subtracted
Results have been corrected to a temperature of 293 K (20 ℃)

Overall M.U.	±5.1%	**Limit of Detection**	0.020µg NO_2
Tube Preparation: 20% TEA /Water			
Analyst Name	Joanna Kowalewska	**Report Checked By**	Adam Robinson
Date of Analysis	22/06/2017	**Date of Report**	22/06/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM9 - QuAAtro Analyser

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....[redacted].....
L. Gates, Laboratory Manager

gradko environmental
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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

COLORIMETRIC ANALYSIS OF NITROGEN DIOXIDE DIFFUSION TUBES

REPORT NUMBER L04785R
BOOKING IN REFERENCE L04785
DESPATCH NOTE 35337
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 04/07/2017

Location	Sample Number	Exposure Data		Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
		Date On	Date Off				
G1	746051	31/05/2017	28/06/2017	671.17	43.50	22.70	2.12
G2	903218	31/05/2017	28/06/2017	671.33	27.61	14.41	1.35
G3	903204	31/05/2017	28/06/2017	670.17	26.24	13.69	1.28
G4	903205	31/05/2017	28/06/2017	670.17	20.98	10.95	1.02
G5	903203	31/05/2017	28/06/2017	669.67	7.38	3.85	0.36
G6	903202	31/05/2017	28/06/2017	669.67	10.13	5.29	0.49
G7	903206	31/05/2017	28/06/2017	670.17	38.50	20.09	1.88
G8	903217	31/05/2017	28/06/2017	667.08	22.94	11.97	1.11
G9	903201	31/05/2017	28/06/2017	669.67	11.12	5.80	0.54
G10	903216	31/05/2017	28/06/2017	666.75	21.85	11.41	1.06
A1	903199	31/05/2017	28/06/2017	671.17	9.86	5.15	0.48
A2	903200	31/05/2017	28/06/2017	671.17	4.94	2.58	0.24
A3	746041	31/05/2017	28/06/2017	671.17	9.72	5.07	0.47
A4	746040	31/05/2017	28/06/2017	671.17	3.85	2.01	0.19
A5	746039	31/05/2017	28/06/2017	671.17	6.95	3.63	0.34
A6	746030	31/05/2017	28/06/2017	671.08	13.06	6.82	0.64
A7	746029	31/05/2017	28/06/2017	671.25	9.33	4.87	0.46
A8	746031	31/05/2017	28/06/2017	671.08	7.13	3.72	0.35
A10	746032	31/05/2017	28/06/2017	671.25	5.86	3.06	0.29
A12	903198	31/05/2017	28/06/2017	671.33	8.20	4.28	0.40
A13	903219	31/05/2017	28/06/2017	671.33	14.67	7.66	0.72
A14	903197	31/05/2017	28/06/2017	671.42	8.14	4.25	0.40
A15	746052	31/05/2017	28/06/2017	671.17	37.70	19.68	1.84
A17	903210	31/05/2017	28/06/2017	666.50	10.73	5.60	0.52
A18	903212	31/05/2017	28/06/2017	666.67	11.66	6.09	0.57
A19	903213	31/05/2017	28/06/2017	666.67	36.37	18.98	1.76
BLANK	903209			671.42	0.23	0.12	0.01

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....[redacted].....
L. Gates, Laboratory Manager

(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Laboratory Blank	671.42	0.00	0.00	0.000

Comment: Results are not blank subtracted

Results have been corrected to a temperature of 293 K (20 °C)

Overall M.U. ±5.1% **Limit of Detection** 0.020µg NO_2

Tube Preparation: 20% TEA /Water

Analyst Name Joanna Kowalewska **Report Checked By** Jacob Harland

Date of Analysis 18/07/2017 **Date of Report** 18/07/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM9 - QuAAtro Analyser

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

gradko environmental
(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

COLORIMETRIC ANALYSIS OF NITROGEN DIOXIDE DIFFUSION TUBES

REPORT NUMBER L05483R
BOOKING IN REFERENCE L05483
DESPATCH NOTE 35337
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
2 City Walk
Leeds
LS119AR
DATE SAMPLES RECEIVED 04/08/2017

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
G1	934779	28/06/2017	02/08/2017	837.83	71.70	37.42	4.37
G2	934787	28/06/2017	02/08/2017	843.50	26.74	13.95	1.64
G3	934775	28/06/2017	02/08/2017	843.08	21.54	11.24	1.32
G4	934774	28/06/2017	02/08/2017	843.08	19.78	10.32	1.21
G5	934776	28/06/2017	02/08/2017	843.67	9.07	4.73	0.56
G6	934777	28/06/2017	02/08/2017	843.67	13.72	7.16	0.84
G7	934773	28/06/2017	02/08/2017	843.00	44.54	23.25	2.73
G9	934778	28/06/2017	02/08/2017	843.50	12.69	6.62	0.78
G10	934788	28/06/2017	02/08/2017	843.17	22.65	11.82	1.39
A1	934782	28/06/2017	02/08/2017	843.63	15.85	8.27	0.97
A3	934781	28/06/2017	02/08/2017	844.58	11.91	6.22	0.73
A4	934799	28/06/2017	02/08/2017	844.50	3.88	2.02	0.24
A5	934798	28/06/2017	02/08/2017	844.58	5.42	2.83	0.33
A6	934797	28/06/2017	02/08/2017	844.00	14.09	7.35	0.86
A7	934796	28/06/2017	02/08/2017	844.00	10.58	5.52	0.65
A8	934794	28/06/2017	02/08/2017	844.58	7.54	3.94	0.46
A9	934795	28/06/2017	02/08/2017	844.67	4.45	2.32	0.27
A10	934793	28/06/2017	02/08/2017	844.75	6.09	3.18	0.37
A11	934783	28/06/2017	02/08/2017	841.25	12.54	6.55	0.77
A12	934784	28/06/2017	02/08/2017	843.50	9.88	5.16	0.61
A13	934786	28/06/2017	02/08/2017	843.50	13.82	7.21	0.85
A14	934785	28/06/2017	02/08/2017	843.50	9.88	5.16	0.61
A15	934792	28/06/2017	02/08/2017	844.08	39.77	20.76	2.44
A16	934772	28/06/2017	02/08/2017	843.00	7.87	4.11	0.48
A17	934771	28/06/2017	02/08/2017	843.33	12.63	6.59	0.77
A18	934770	28/06/2017	02/08/2017	843.17	14.59	7.61	0.89
A19	934789	28/06/2017	02/08/2017	842.75	43.77	22.84	2.68
Laboratory Blank				844.75	0.31	0.16	0.019

Comment: Results are not blank subtracted

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Results have been corrected to a temperature of 293 K (20 ℃)

Overall M.U.	±5.1%	**Limit of Detection**	0.020µg NO_2
Tube Preparation: 20% TEA /Water			
Analyst Name	Toni Attrill	**Report Checked By**	Jacob Harland
Date of Analysis	16/08/2017	**Date of Report**	16/08/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM9 - QuAAtro Analyser

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

COLORIMETRIC ANALYSIS OF NITROGEN DIOXIDE DIFFUSION TUBES

REPORT NUMBER L06397R
BOOKING IN REFERENCE L06397
DESPATCH NOTE 35337
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 06/09/2017

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
G1	934820	02/08/2017	30/08/2017	679.25	70.33	36.71	3.47
G2	934819	02/08/2017	30/08/2017	672.50	29.75	15.53	1.45
G3	934806	02/08/2017	30/08/2017	672.00	29.22	15.25	1.43
G4	934805	02/08/2017	30/08/2017	672.92	24.27	12.67	1.19
G5	934807	02/08/2017	30/08/2017	672.00	8.13	4.24	0.40
G6	934808	02/08/2017	30/08/2017	672.08	9.95	5.19	0.49
G7	934804	02/08/2017	30/08/2017	673.00	45.98	24.00	2.25
G8	934800	02/08/2017	30/08/2017	672.67	20.90	10.91	1.02
G9	934809	02/08/2017	30/08/2017	672.25	11.75	6.13	0.57
G10	934827	02/08/2017	30/08/2017	672.75	21.25	11.09	1.04
A1	934815	02/08/2017	30/08/2017	673.33	14.12	7.37	0.69
A2	934826	02/08/2017	30/08/2017	672.58	6.32	3.30	0.31
A3	934814	02/08/2017	30/08/2017	672.50	10.72	5.60	0.52
A4	934813	02/08/2017	30/08/2017	672.67	4.30	2.24	0.21
A5	934825	02/08/2017	30/08/2017	672.83	7.55	3.94	0.37
A6	934812	02/08/2017	30/08/2017	673.00	13.06	6.82	0.64
A7	934823	02/08/2017	30/08/2017	673.00	11.29	5.89	0.55
A8	934822	02/08/2017	30/08/2017	672.92	7.36	3.84	0.36
A9	934824	02/08/2017	30/08/2017	672.67	5.17	2.70	0.25
A10	934821	02/08/2017	30/08/2017	672.92	6.36	3.32	0.31
A11	934816	02/08/2017	30/08/2017	673.33	13.24	6.91	0.65
A12	934811	02/08/2017	30/08/2017	675.75	10.61	5.54	0.52
A13	934818	02/08/2017	30/08/2017	672.58	16.75	8.74	0.82
A14	934817	02/08/2017	30/08/2017	672.58	10.47	5.47	0.51
A15	934810	02/08/2017	30/08/2017	673.00	40.60	21.19	1.99
A16	934803	02/08/2017	30/08/2017	673.00	8.57	4.47	0.42
A18	934802	02/08/2017	30/08/2017	672.83	<0.41	<0.21	<0.020
A19	934801	02/08/2017	30/08/2017	673.33	44.57	23.26	2.18
Laboratory Blank				679.25	0.00	0.00	0.000

REPORT OFFICIALLY CHECKED

Gradko International Ltd
This signature confirms the authenticity of these results
Signed.....
L. Gates, Laboratory Manager

(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Comment: Results are not blank subtracted

Results reported as <0.020 are below the reporting limit.

Results have been corrected to a temperature of 293 K (20 ℃)

Overall M.U.	±5.9%	**Limit of Detection**	0.020µg NO_2

Tube Preparation: 20% TEA /Water

Analyst Name	Amber Silvester	**Report Checked By**	Adam Robinson
Date of Analysis	19/09/2017	**Date of Report**	19/09/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM9 - QuAAtro Analyser

REPORT OFFICIALLY CHECKED

Gradko International Ltd
This signature confirms the authenticity of these results
Signed.....
L. Gates, Laboratory Manager

(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

COLORIMETRIC ANALYSIS OF NITROGEN DIOXIDE DIFFUSION TUBES

REPORT NUMBER L06966R
BOOKING IN REFERENCE L06966
DESPATCH NOTE 35338
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 02/10/2017

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
A1	1019638	30/08/2017	27/09/2017	668.75	15.78	8.24	0.77
A3	1019639	30/08/2017	27/09/2017	668.92	10.00	5.22	0.49
A4	1019640	30/08/2017	27/09/2017	668.83	2.41	1.26	0.12
A5	1019641	30/08/2017	27/09/2017	668.67	6.32	3.30	0.31
A6	1019625	30/08/2017	27/09/2017	664.17	14.36	7.49	0.69
A7	1019624	30/08/2017	27/09/2017	664.00	12.02	6.27	0.58
A8	1019626	30/08/2017	27/09/2017	664.17	8.14	4.25	0.39
A9	1019628	30/08/2017	27/09/2017	664.67	3.81	1.99	0.18
A10	1019627	30/08/2017	27/09/2017	664.17	6.38	3.33	0.31
A11	1019629	30/08/2017	27/09/2017	666.67	10.26	5.35	0.50
A12	1019630	30/08/2017	27/09/2017	664.58	12.53	6.54	0.61
A13	1019632	30/08/2017	27/09/2017	667.93	15.12	7.89	0.73
A14	1019631	30/08/2017	27/09/2017	667.92	10.98	5.73	0.53
A15	1019633	30/08/2017	27/09/2017	664.67	39.95	20.85	1.93
A16	1019637	30/08/2017	27/09/2017	670.00	8.46	4.42	0.41
A17	1019636	30/08/2017	27/09/2017	669.75	13.60	7.10	0.66
A18	1019634	30/08/2017	27/09/2017	669.33	15.23	7.95	0.74
A19	1019635	30/08/2017	27/09/2017	669.25	59.13	30.86	2.88
Laboratory Blank				670.00	0.33	0.17	0.016

Comment: Results are not blank subtracted
Results have been corrected to a temperature of 293 K (20 ℃)

Overall M.U. ±7.4% **Limit of Detection** 0.020µg NO_2
Tube Preparation: 20% TEA /Water
Analyst Name Amber Silvester **Report Checked By** Adam Robinson
Date of Analysis 20/10/2017 **Date of Report** 20/10/2017

REPORT OFFICIALLY CHECKED

Gradko International Ltd
This signature confirms the authenticity of these results
Signed.....
L. Gates, Laboratory Manager

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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Analysis carried out in accordance with documented in-house Laboratory Method GLM9 - QuAAtro Analyser

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L. Gates, Laboratory Manager

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER L07855R
BOOKING IN REFERENCE L07855
DESPATCH NOTE 39413
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
Aecom
2 City Walk
Leeds
LS11 9AR
DATE SAMPLES RECEIVED 03/11/2017

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
G1	1031540	27/09/2017	01/11/2017	839.08	26.86	14.02	1.64
G2	1031539	27/09/2017	01/11/2017	839.00	26.89	14.04	1.64
G3	1031538	27/09/2017	01/11/2017	838.92	24.41	12.74	1.49
G4	1031541	27/09/2017	01/11/2017	839.08	23.88	12.47	1.46
G5	1031546	27/09/2017	01/11/2017	839.58	8.22	4.29	0.50
G7	1031542	27/09/2017	01/11/2017	839.08	29.89	15.60	1.82
G8	1031544	27/09/2017	01/11/2017	839.33	22.46	11.72	1.37
G9	1031545	27/09/2017	01/11/2017	839.58	13.18	6.88	0.80
G10	1031543	27/09/2017	01/11/2017	839.33	25.23	13.17	1.54
Laboratory Blank				839.58	0.28	0.15	0.017

Comment: Results are not blank subtracted
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8%
Limit of Detection 0.010 µgNO_2
Tube Preparation : 20% TEA / Water
Analysed on UV 08 Camspec M550
Analyst Name Molly Thacker
Report Checked By Jacob Harland

Date of Analysis 14/11/2017
Date of Report 14/11/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

gradko environmental
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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER L07870R
BOOKING IN REFERENCE L07870
DESPATCH NOTE 35339
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 06/11/2017
JOB REFERENCE etxpp@ynysmon.gov.uk

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
A1	1031561	27/09/2017	02/11/2017	863.17	14.20	7.41	0.89
A2	1031563	27/09/2017	02/11/2017	863.08	6.39	3.34	0.40
A3	1031564	27/09/2017	02/11/2017	864.67	12.42	6.48	0.78
A4	1031565	27/09/2017	02/11/2017	864.67	4.25	2.22	0.27
A5	1031566	27/09/2017	02/11/2017	864.75	8.55	4.46	0.54
A6	1031560	27/09/2017	02/11/2017	865.00	16.30	8.51	1.02
A9	1031562	27/09/2017	02/11/2017	865.17	6.01	3.14	0.38
A10	1031567	27/09/2017	02/11/2017	868.83	7.90	4.12	0.50
A11	1031568	27/09/2017	02/11/2017	868.67	4.74	2.47	0.30
A12	1031569	27/09/2017	02/11/2017	868.75	12.33	6.44	0.78
A13	1031570	27/09/2017	02/11/2017	868.73	19.35	10.10	1.22
A14	1031571	27/09/2017	02/11/2017	868.75	11.74	6.13	0.74
A15	1031575	27/09/2017	02/11/2017	869.75	41.96	21.90	2.65
A16	1031572	27/09/2017	02/11/2017	868.33	10.57	5.52	0.67
A17	1031573	27/09/2017	02/11/2017	868.83	13.98	7.29	0.88
A19	1031574	27/09/2017	02/11/2017	869.33	40.96	21.38	2.59
Laboratory Blank				869.75	0.11	0.06	0.007

Comment: Results are not blank subtracted
Tube 103156 was dirty when received. Result may be compromised.
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8%
Limit of Detection 0.010 µgNO_2
Tube Preparation : 20% TEA / Water
Analysed on UV 08 Camspec M550
Analyst Name Molly Thacker
Report Checked By Jacob Harland

Date of Analysis 15/11/2017
Date of Report 15/11/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

The Diffusion Tubes have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures calculations and assessments involving the exposure procedures and periods provided by the client are not within the scope of our UKAS accreditation. Those results obtained using exposure data shall be indicated by an asterisk (*). Any queries concerning the data in this report should be directed to the Laboratory Manager Gradko International Ltd. This report is not to be reproduced, except in full, without the written permission of Gradko International Ltd.

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tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER L08727R
BOOKING IN REFERENCE L08727
DESPATCH NOTE 35339
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
2 City Walk, Leeds, LS119AR
DATE SAMPLES RECEIVED 08/12/2017

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m³ *	ppb *	TOTAL µg NO_2
A1	1031596	02/11/2017	05/12/2017	795.17	20.56	10.73	1.19
A2	1031595	02/11/2017	05/12/2017	795.00	5.81	3.03	0.34
A3	1031597	02/11/2017	05/12/2017	792.50	16.06	8.38	0.93
A4	1031598	02/11/2017	05/12/2017	792.00	4.54	2.37	0.26
A5	1031599	02/11/2017	05/12/2017	791.67	9.34	4.87	0.54
A6	1031585	02/11/2017	05/12/2017	794.92	21.74	11.35	1.26
A7	1031586	02/11/2017	05/12/2017	795.17	19.81	10.34	1.15
A8	1031589	02/11/2017	05/12/2017	795.33	12.13	6.33	0.70
A9	1031588	02/11/2017	05/12/2017	794.83	6.31	3.29	0.36
A10	1031587	02/11/2017	05/12/2017	791.00	10.92	5.70	0.63
A11	1031584	02/11/2017	05/12/2017	790.50	20.19	10.54	1.16
A12	1031583	02/11/2017	05/12/2017	790.08	20.64	10.77	1.19
A13	1031582	02/11/2017	05/12/2017	789.92	19.83	10.35	1.14
A14	1031581	02/11/2017	05/12/2017	788.25	19.89	10.38	1.14
A15	1031576	02/11/2017	05/12/2017	789.67	43.35	22.62	2.49
A16	1031580	02/11/2017	05/12/2017	789.25	15.04	7.85	0.86
A17	1031579	02/11/2017	05/12/2017	789.00	19.79	10.33	1.13
A18	1031577	02/11/2017	05/12/2017	788.83	22.18	11.58	1.27
A19	1031578	02/11/2017	05/12/2017	792.00	44.84	23.40	2.58
BLANK	1031593			795.33	0.08	0.04	0.004
Laboratory Blank				795.33	0.16	0.08	0.009

Comment: Results are not blank subtracted

Results have been corrected to a temperature of 293 K (20°)

The Diffusion Tubes have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures calculations and assessments involving the exposure procedures and periods provided by the client are not within the scope of our UKAS accreditation. Those results obtained using exposure data shall be indicated by an asterisk (*). Any queries concerning the data in this report should be directed to the Laboratory Manager Gradko International Ltd. This report is not to be reproduced, except in full, without the written permission of Gradko International Ltd.

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L. Gates, Laboratory Manager

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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Overall M.U. ±7.8%

Limit of Detection 0.017μgNO_2

Tube Preparation : 20% TEA / Water

Analysed on UV 04 Camspec M550

Analyst Name Oliver Branchflower

Report Checked By K. Paldamova

Date of Analysis 18/12/2017

Date of Report 18/12/2017

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....[redacted].....
L. Gates, Laboratory Manager

gradko environmental
(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER L08859R
BOOKING IN REFERENCE L08859
DESPATCH NOTE 39413
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 11/12/2017

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
G3	1031549	01/11/2017	06/12/2017	843.58	25.28	13.19	1.55
G2	1031552	01/11/2017	06/12/2017	842.00	44.55	23.25	2.73
G1	1031553**	01/11/2017	06/12/2017	842.00	72.81	38.00	4.46
G4	1031550	01/11/2017	06/12/2017	843.25	27.96	14.59	1.71
G7	1031551	01/11/2017	06/12/2017	843.33	<0.16	<0.09	<0.010
G10	1031547	01/11/2017	06/12/2017	842.42	29.97	15.64	1.84
G8	1031548	01/11/2017	06/12/2017	842.42	30.51	15.92	1.87
G9	1031554	01/11/2017	06/12/2017	838.42	17.04	8.89	1.04
G6	1031555	01/11/2017	06/12/2017	841.33	15.22	7.95	0.93
G5	1031556	01/11/2017	06/12/2017	841.50	13.99	7.30	0.86
Laboratory Blank				843.58	0.05	0.03	0.003

Comment: Results are not blank subtracted
Tube 1031551 contained water droplets. Result may be compromised.
Tubes marked ** were diluted to read within our UKAS accredited calibration range.
Results reported as <0.010 are below the reporting limit.
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8%
Limit of Detection 0.010µgNO_2
Analysed on UV05 Camspec M550
Tube Preparation : 20% TEA / Water
Analyst Name Amber Silvester
Report Checked By Jacob Harland
Date of Analysis 20/12/2017
Date of Report 21/12/2017

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

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L. Gates, Laboratory Manager

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER M00280R
BOOKING IN REFERENCE M00280
DESPATCH NOTE 40556
CUSTOMER AECOM Ltd (Q) Attn: Tom Stenhouse
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 04/01/2018

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m³ *	ppb *	TOTAL µg NO_2
G10	1068802	06/12/2017	02/01/2018	645.83	30.16	15.74	1.42
G8	1068803	06/12/2017	02/01/2018	645.75	29.26	15.27	1.37
G3	1068797	06/12/2017	02/01/2018	644.83	23.45	12.24	1.10
G4	1068800	06/12/2017	02/01/2018	645.25	23.59	12.31	1.11
G7	1068801	06/12/2017	02/01/2018	645.17	28.74	15.00	1.35
G2	1068798	07/12/2017	02/01/2018	622.42	26.79	13.98	1.21
G1	1068799	07/12/2017	02/01/2018	622.42	65.36	34.11	2.96
G9	1068804	07/12/2017	02/01/2018	622.75	14.13	7.37	0.64
G6	1068805	07/12/2017	02/01/2018	622.67	12.38	6.46	0.56
G5	1068806	07/12/2017	02/01/2018	622.67	9.84	5.14	0.45
Tavel Blank	1068817			645.83	0.19	0.10	0.01
Laboratory Blank				645.83	0.23	0.12	0.011

Comment: Results are not blank subtracted
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8% **Limit of Detection** 0.017µgNO_2
Tube Preparation : 20% TEA / Water Analysed on UV 04 Camspec M550
Analyst Name Oliver Branchflower **Report Checked By** Adam Robinson

Date of Analysis 12/01/2018 **Date of Report** 12/01/2018

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

gradko environmental
(A division of Gradko International Ltd.)
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tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER M00545R
BOOKING IN REFERENCE M00545
DESPATCH NOTE 40555
CUSTOMER AECOM Ltd (Q) Attn: Tom Stenhouse
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 08/01/2018

Location	Sample Number	Exposure Data		Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
		Date On	Date Off				
A1	1068763	05/12/2017	05/01/2018	738.58	16.21	8.46	0.87
A2	1068762	05/12/2017	05/01/2018	738.67	7.26	3.79	0.39
A3	1068761	05/12/2017	05/01/2018	739.50	12.45	6.50	0.67
A4	1068760	05/12/2017	05/01/2018	739.92	4.40	2.30	0.24
A5	1068759	05/12/2017	05/01/2018	740.25	9.13	4.76	0.49
A6	1068757	05/12/2017	05/01/2018	741.08	20.72	10.82	1.12
A7	1068758	05/12/2017	05/01/2018	740.92	16.61	8.67	0.89
A9	1068756	05/12/2017	05/01/2018	740.83	6.10	3.18	0.33
A10	1068755	05/12/2017	05/01/2018	741.17	7.82	4.08	0.42
A11	1068754	05/12/2017	05/01/2018	741.58	16.09	8.40	0.87
A12	1068773	05/12/2017	05/01/2018	741.92	17.55	9.16	0.95
A13	1068772	05/12/2017	05/01/2018	742.03	18.35	9.58	0.99
A14	1068771	05/12/2017	05/01/2018	742.08	16.61	8.67	0.90
A15	1068766	05/12/2017	05/01/2018	743.42	41.48	21.65	2.24
A16	1068770	05/12/2017	05/01/2018	742.58	13.14	6.86	0.71
A17	1068767	05/12/2017	05/01/2018	742.75	16.93	8.84	0.91
A18	1068769	05/12/2017	05/01/2018	742.83	19.21	10.02	1.04
A19	1068768	05/12/2017	05/01/2018	742.75	39.37	20.55	2.13
BLANK	1068765			743.42	0.25	0.13	0.01
Laboratory Blank				743.42	0.11	0.06	0.006

Comment: Results are not blank subtracted
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8% **Limit of Detection** 0.010µgNO_2

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....[redacted].....
L. Gates, Laboratory Manager

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St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Analysed on UV05 Camspec M550

Tube Preparation : 20% TEA / Water

Analyst Name	Amber Silvester	**Report Checked By**	Duncan Wilson
Date of Analysis	18/01/2018	**Date of Report**	18/01/2018

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....[redacted].....
L. Gates, Laboratory Manager

gradko environmental
(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER M01339R
BOOKING IN REFERENCE M01339
DESPATCH NOTE 40555
CUSTOMER AECOM Ltd (Q) Attn: Tom Stenhouse
2 City Walk
Leeds
LS11 9AR
DATE SAMPLES RECEIVED 05/02/2018

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
A1	1068774	05/01/2018	02/02/2018	672.25	18.59	9.70	0.91
A2	1068775	05/01/2018	02/02/2018	672.33	9.12	4.76	0.45
A3	1068776	05/01/2018	02/02/2018	672.25	14.92	7.79	0.73
A4	1068777	05/01/2018	02/02/2018	672.33	5.58	2.91	0.27
A5	1068778	05/01/2018	02/02/2018	672.25	10.46	5.46	0.51
A6	1068779	05/01/2018	02/02/2018	672.17	21.43	11.18	1.05
A7	1068780	05/01/2018	02/02/2018	672.33	18.06	9.43	0.88
A8	1068781	05/01/2018	02/02/2018	673.33	11.41	5.96	0.56
A9	1068782	05/01/2018	02/02/2018	673.33	9.58	5.00	0.47
A10	1068783	05/01/2018	02/02/2018	673.67	9.09	4.75	0.45
A11	1068784	05/01/2018	02/02/2018	673.75	18.06	9.43	0.88
A12	1068785	05/01/2018	02/02/2018	673.75	19.74	10.30	0.97
A13	1068786	05/01/2018	02/02/2018	673.80	21.98	11.47	1.08
A14	1068787	05/01/2018	02/02/2018	673.83	17.27	9.01	0.85
A15	1068788	05/01/2018	02/02/2018	673.08	39.67	20.70	1.94
A16	1068789	05/01/2018	02/02/2018	673.58	14.84	7.74	0.73
A17	1068790	05/01/2018	02/02/2018	673.58	18.19	9.49	0.89
A18	1068791	05/01/2018	02/02/2018	673.75	21.39	11.16	1.05
A19	1068792	05/01/2018	02/02/2018	673.83	33.61	17.54	1.65
BLANK	1068764			673.83	1.65	0.86	0.08
Laboratory Blank				673.83	0.25	0.13	0.012

Comment: Results are not blank subtracted
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8%
Limit of Detection 0.017µgNO_2
Tube Preparation : 20% TEA / Water
Analysed on UV 04 Camspec M550
Analyst Name Oliver Branchflower
Report Checked By Jacob Harland

Date of Analysis 20/02/2018
Date of Report 20/02/2018
Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

Gradko International Ltd
This signature confirms the authenticity of these results
Signed.....
L. Gates, Laboratory Manager

(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER M01367R
BOOKING IN REFERENCE M01367
DESPATCH NOTE 40556
CUSTOMER AECOM Ltd (Q) Attn: Tom Stenhouse
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 06/02/2018

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m³ *	ppb *	TOTAL µg NO_2
G3	1068807	02/01/2018	02/02/2018	743.00	27.30	14.25	1.47
G2	1068808	02/01/2018	02/02/2018	742.92	32.50	16.96	1.76
G1	1068809**	02/01/2018	02/02/2018	743.58	73.42	38.32	3.97
G4	1068810	02/01/2018	02/02/2018	743.50	23.93	12.49	1.29
G10	1068812	02/01/2018	02/02/2018	743.50	31.80	16.60	1.72
G8	1068813	02/01/2018	02/02/2018	743.50	26.60	13.88	1.44
G9	1068814	02/01/2018	02/02/2018	743.58	14.92	7.79	0.81
G6	1068815	02/01/2018	02/02/2018	743.50	14.85	7.75	0.80
G5	1068816	02/01/2018	02/02/2018	743.50	10.35	5.40	0.56
Travel Blank	1068820			743.58	0.27	0.14	0.01
Laboratory Blank				743.58	0.24	0.13	0.013

Comment: Results are not blank subtracted
Tubes marked ** were diluted to read within our UKAS accredited calibration range.
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8% **Limit of Detection** 0.010µgNO_2
Tube Preparation : 20% TEA / Water Analysed on UV05 Camspec M550
Analyst Name Amber Silvester **Report Checked By** Adam Robinson

Date of Analysis 22/02/2018 **Date of Report** 22/02/2018

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

Gradko International Ltd
This signature confirms the authenticity of these results
Signed.....
L. Gates, Laboratory Manager

gradko environmental
(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER M02064R
BOOKING IN REFERENCE M02064
DESPATCH NOTE 40559
CUSTOMER AECOM Ltd (Q) Attn: Tom Stenhouse
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP
DATE SAMPLES RECEIVED 08/03/2018

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
G3	1098401	02/02/2018	05/03/2018	745.67	22.98	11.99	1.25
G1	1098403**	02/02/2018	05/03/2018	745.00	57.94	30.24	3.14
G4	1098404	02/02/2018	05/03/2018	745.00	23.72	12.38	1.28
G7	1098405	02/02/2018	05/03/2018	745.00	29.13	15.20	1.58
G10	1098406	02/02/2018	05/03/2018	744.92	28.77	15.02	1.56
G8	1098407	02/02/2018	05/03/2018	745.08	28.77	15.01	1.56
G9	1098408	02/02/2018	05/03/2018	745.17	0.25	0.13	0.01
G6	1098409	02/02/2018	05/03/2018	745.25	12.84	6.70	0.70
G5	1098410	02/02/2018	05/03/2018	745.25	12.73	6.64	0.69
Travel Blank	1098411			745.67	0.58	0.30	0.03
Laboratory Blank				745.67	0.24	0.13	0.013

Comment: Results are not blank subtracted
Tubes marked ** were diluted to read within our UKAS accredited calibration range.
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8%
Limit of Detection 0.017µgNO_2
Analysed on UV 04 Camspec M550
Tube Preparation : 20% TEA / Water
Analyst Name Toni Attrill
Report Checked By Duncan Wilson

Date of Analysis 22/03/2018
Date of Report 22/03/2018

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

gradko environmental
(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER M02082R

BOOKING IN REFERENCE M02082
DESPATCH NOTE 40557
CUSTOMER AECOM Ltd (Q) Attn: Gareth Hodgkiss
10th Floor
Sunley House
4 Bedford Park
Croydon
CR0 2AP

DATE SAMPLES RECEIVED 09/03/2018

Location	Sample Number	Exposure Data Date On	Date Off	Time (hr.)	µg/m^3 *	ppb *	TOTAL µg NO_2
A1	1098159	02/02/2018	26/02/2018	581.08	20.26	10.57	0.86
A2	1098160	02/02/2018	26/02/2018	580.92	9.57	4.99	0.40
A3	1098161	02/02/2018	26/02/2018	581.00	18.64	9.73	0.79
A4	1098162	02/02/2018	26/02/2018	581.00	6.75	3.52	0.28
A5	1098163	02/02/2018	26/02/2018	581.00	12.68	6.62	0.54
A6	1098157	02/02/2018	26/02/2018	579.17	24.48	12.78	1.03
A7	1098158	02/02/2018	26/02/2018	579.17	20.74	10.82	0.87
A8	1098156	02/02/2018	26/02/2018	577.83	11.78	6.15	0.49
A9	1098164	02/02/2018	26/02/2018	579.75	9.04	4.72	0.38
A10	1098165	02/02/2018	26/02/2018	579.50	8.80	4.59	0.37
A11	1098166	02/02/2018	26/02/2018	579.33	24.62	12.85	1.04
A12	1098167	02/02/2018	26/02/2018	579.33	20.31	10.60	0.86
A13	1098168	02/02/2018	26/02/2018	579.33	19.87	10.37	0.84
A14	1098169	02/02/2018	26/02/2018	579.33	2.93	1.53	0.12
A15	1098155	02/02/2018	26/02/2018	576.17	39.99	20.87	1.67
A16	1098170	02/02/2018	26/02/2018	579.25	16.55	8.64	0.70
A17	1098171	02/02/2018	26/02/2018	579.17	21.22	11.08	0.89
A18	1098172	02/02/2018	26/02/2018	579.17	24.53	12.80	1.03
A19	1098173	02/02/2018	26/02/2018	579.17	38.10	19.89	1.60
BLANK	1098154			581.08	1.19	0.62	0.05
Laboratory Blank				581.08	0.38	0.20	0.016

Comment: Results are not blank subtracted
Results have been corrected to a temperature of 293 K (20°)

Overall M.U. ±7.8%

Limit of Detection 0.010 µgNO_2

Tube Preparation : 20% TEA / Water

Analysed on UV 08 Camspec M550

REPORT OFFICIALLY CHECKED

Gradko International Ltd
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Signed.....
L. Gates, Laboratory Manager

(A division of Gradko International Ltd.)
St. Martins House, 77 Wales Street Winchester, Hampshire SO23 0RH
tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

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LABORATORY ANALYSIS REPORT

Analyst Name	Molly Thacker	**Report Checked By**	Vanessa Kellie
Date of Analysis	27/03/2018	**Date of Report**	27/03/2018

Analysis carried out in accordance with documented in-house Laboratory Method GLM7

REPORT OFFICIALLY CHECKED

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Signed.....
L. Gates, Laboratory Manager

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Sub-Appendix D – Generator Datasheet

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PERFORMANCE DATA[DM8454]

August 10, 2012

Performance Number: DM8454 **Change Level: 01**

SALES MODEL:	3516C	**COMBUSTION:**	DI
ENGINE POWER (BHP):	2,722	**ENGINE SPEED (RPM):**	1,800
GEN POWER WITH FAN (EKW):	1,825.0	**HERTZ:**	60
COMPRESSION RATIO:	14.7	**FAN POWER (HP):**	144.8
APPLICATION:	PACKAGED GENSET	**ASPIRATION:**	TA
RATING LEVEL:	PRIME	**AFTERCOOLER TYPE:**	ATAAC
PUMP QUANTITY:	2	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
FUEL TYPE:	DIESEL	**INLET MANIFOLD AIR TEMP (F):**	120
MANIFOLD TYPE:	DRY	**JACKET WATER TEMP (F):**	210.2
GOVERNOR TYPE:	ADEM3	**TURBO CONFIGURATION:**	PARALLEL
ELECTRONICS TYPE:	ADEM3	**TURBO QUANTITY:**	4
CAMSHAFT TYPE:	STANDARD	**TURBOCHARGER MODEL:**	GTA5518BN-56T-1.12
IGNITION TYPE:	CI	**CERTIFICATION YEAR:**	2008
INJECTOR TYPE:	EUI	**CRANKCASE BLOWBY RATE (FT3/HR):**	2,690.7
FUEL INJECTOR:	2664387	**FUEL RATE (RATED RPM) NO LOAD (GAL/HR):**	13.7
REF EXH STACK DIAMETER (IN):	12	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,244.1
MAX OPERATING ALTITUDE (FT):	3,937		

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
1,825.0	100	2,721	284	0.330	128.4	74.6	120.0	1,080.6	67.3	729.8
1,642.5	90	2,450	256	0.335	117.1	69.8	118.7	1,040.1	62.0	702.9
1,460.0	80	2,188	229	0.341	106.6	64.8	117.4	1,005.1	56.8	683.4
1,368.8	75	2,059	215	0.345	101.4	62.1	116.8	987.9	54.2	675.3
1,277.5	70	1,931	202	0.348	96.0	59.1	116.1	970.6	51.4	667.6
1,095.0	60	1,678	175	0.355	85.0	52.1	114.7	936.4	44.9	654.3
912.5	50	1,429	149	0.357	72.9	42.7	113.1	897.8	36.8	647.4
730.0	40	1,181	123	0.358	60.3	31.8	111.4	849.9	27.9	643.2
547.5	30	932	97	0.368	49.0	22.7	110.4	792.6	20.9	633.2
456.2	25	806	84	0.377	43.4	18.8	110.1	757.8	18.0	624.1
365.0	20	678	71	0.391	37.9	15.2	109.7	717.6	15.4	611.2
182.5	10	416	43	0.448	26.7	9.1	109.1	599.5	11.0	542.8

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
1,825.0	100	2,721	79	435.7	6,268.9	14,338.0	27,207.2	28,105.6	5,926.5	5,492.9
1,642.5	90	2,450	74	412.9	6,078.0	13,483.9	26,275.7	27,094.6	5,702.7	5,307.2
1,460.0	80	2,188	69	390.8	5,848.9	12,707.3	25,203.9	25,948.7	5,465.7	5,103.8
1,368.8	75	2,059	66	380.0	5,717.7	12,303.7	24,603.8	25,313.9	5,329.9	4,984.5
1,277.5	70	1,931	63	368.2	5,567.0	11,865.4	23,915.9	24,589.3	5,175.4	4,847.0
1,095.0	60	1,678	56	340.7	5,183.9	10,864.4	22,185.9	22,781.5	4,795.0	4,502.4
912.5	50	1,429	46	303.3	4,622.0	9,569.6	19,690.3	20,200.9	4,249.9	3,997.8
730.0	40	1,181	34	258.8	3,948.4	8,096.6	16,730.6	17,153.0	3,609.6	3,400.7
547.5	30	932	25	218.2	3,368.4	6,825.8	14,210.5	14,552.7	3,071.0	2,900.3
456.2	25	806	21	199.4	3,113.1	6,238.2	13,110.4	13,414.0	2,830.1	2,677.7
365.0	20	678	17	181.4	2,876.7	5,668.5	12,097.3	12,362.8	2,602.6	2,467.9
182.5	10	416	11	149.1	2,472.2	4,547.9	10,369.3	10,556.0	2,230.7	2,131.7

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHUAST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
1,825.0	100	2,721	41,176	7,412	94,610	44,575	14,683	34,659	115,390	275,674	293,661
1,642.5	90	2,450	38,527	7,062	86,743	39,775	13,387	31,101	103,910	251,335	267,735
1,460.0	80	2,188	36,026	6,778	79,970	35,886	12,183	27,695	92,774	228,740	243,665
1,368.8	75	2,059	34,762	6,647	76,682	34,111	11,589	26,040	87,309	217,577	231,774
1,277.5	70	1,931	33,450	6,524	73,236	32,303	10,979	24,222	81,880	206,135	219,585
1,095.0	60	1,678	30,660	6,282	65,884	28,619	9,717	20,121	71,174	182,439	194,344
912.5	50	1,429	27,479	6,000	57,347	24,769	8,336	15,125	60,594	156,515	166,727
730.0	40	1,181	24,011	5,699	48,105	20,709	6,897	9,899	50,098	129,496	137,945
547.5	30	932	20,680	5,394	39,921	16,936	5,597	6,112	39,536	105,077	111,933
456.2	25	806	18,997	5,238	36,022	15,084	4,965	4,652	34,192	93,210	99,292
365.0	20	678	17,246	5,079	32,081	13,220	4,333	3,430	28,772	81,353	86,661
182.5	10	416	13,382	4,712	23,624	8,251	3,047	1,543	17,652	57,208	60,941

PERFORMANCE DATA[DM8454]

PERFORMANCE DATA[DM8454]

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		EKW	1,825.0	1,368.8	912.5	456.2	182.5
ENGINE POWER		BHP	2,721	2,059	1,429	806	416
PERCENT LOAD		%	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	16,211	8,787	5,621	4,219	3,018
TOTAL CO		G/HR	1,310	758	1,119	1,803	1,832
TOTAL HC		G/HR	463	490	508	414	450
PART MATTER		G/HR	100.3	99.7	149.3	256.4	204.4
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	3,031.7	2,151.1	1,936.1	2,415.5	2,867.1
TOTAL CO	(CORR 5% O2)	MG/NM3	237.1	174.2	373.5	931.1	1,712.5
TOTAL HC	(CORR 5% O2)	MG/NM3	73.4	97.2	140.5	198.7	377.7
PART MATTER	(CORR 5% O2)	MG/NM3	15.6	20.0	46.6	122.2	158.8
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,477	1,048	943	1,177	1,397
TOTAL CO	(CORR 5% O2)	PPM	190	139	299	745	1,370
TOTAL HC	(CORR 5% O2)	PPM	137	181	262	371	705
TOTAL NOX (AS NO2)		G/HP-HR	5.99	4.29	3.95	5.24	7.26
TOTAL CO		G/HP-HR	0.48	0.37	0.79	2.24	4.40
TOTAL HC		G/HP-HR	0.17	0.24	0.36	0.51	1.08
PART MATTER		G/HP-HR	0.04	0.05	0.10	0.32	0.49
TOTAL NOX (AS NO2)		LB/HR	35.74	19.37	12.39	9.30	6.65
TOTAL CO		LB/HR	2.89	1.67	2.47	3.97	4.04
TOTAL HC		LB/HR	1.02	1.08	1.12	0.91	0.99
PART MATTER		LB/HR	0.22	0.22	0.33	0.57	0.45

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	1,825.0	1,368.8	912.5	456.2	182.5
ENGINE POWER		BHP	2,721	2,059	1,429	806	416
PERCENT LOAD		%	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	13,509	7,322	4,684	3,516	2,515
TOTAL CO		G/HR	728	421	622	1,002	1,018
TOTAL HC		G/HR	348	368	382	311	339
TOTAL CO2		KG/HR	1,261	998	717	426	259
PART MATTER		G/HR	71.6	71.2	106.6	183.1	146.0
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,526.5	1,792.6	1,613.4	2,012.9	2,389.2
TOTAL CO	(CORR 5% O2)	MG/NM3	131.7	96.8	207.5	517.3	951.4
TOTAL HC	(CORR 5% O2)	MG/NM3	55.2	73.1	105.6	149.4	284.0
PART MATTER	(CORR 5% O2)	MG/NM3	11.1	14.3	33.3	87.3	113.4
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,231	873	786	981	1,164
TOTAL CO	(CORR 5% O2)	PPM	105	77	166	414	761
TOTAL HC	(CORR 5% O2)	PPM	103	136	197	279	530
TOTAL NOX (AS NO2)		G/HP-HR	4.99	3.57	3.29	4.37	6.05
TOTAL CO		G/HP-HR	0.27	0.21	0.44	1.24	2.45
TOTAL HC		G/HP-HR	0.13	0.18	0.27	0.39	0.81
PART MATTER		G/HP-HR	0.03	0.03	0.07	0.23	0.35
TOTAL NOX (AS NO2)		LB/HR	29.78	16.14	10.33	7.75	5.55
TOTAL CO		LB/HR	1.60	0.93	1.37	2.21	2.24
TOTAL HC		LB/HR	0.77	0.81	0.84	0.69	0.75
TOTAL CO2		LB/HR	2,781	2,199	1,581	939	570
PART MATTER		LB/HR	0.16	0.16	0.24	0.40	0.32
OXYGEN IN EXH		%	11.4	12.6	13.5	14.3	15.8
DRY SMOKE OPACITY		%	0.4	0.5	1.8	3.8	3.1
BOSCH SMOKE NUMBER			0.18	0.23	0.60	1.25	1.14

PERFORMANCE DATA[DM8454]

Regulatory Information

EPA TIER 2		2006 - 2010		
GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 89 SUBPART D AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. GASEOUS EMISSIONS VALUES ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.				
Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	NON-ROAD	TIER 2	CO: 3.5 NOx + HC: 6.4 PM: 0.20

EPA EMERGENCY STATIONARY		2011 - ----		
GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. GASEOUS EMISSIONS LIMIT VALUES ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.				
Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 6.4 PM: 0.20

Altitude Derate Data

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	NORMAL
ALTITUDE (FT)										
0	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722
1,000	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,722
2,000	2,722	2,722	2,722	2,722	2,722	2,722	2,722	2,715	2,669	2,722
3,000	2,722	2,722	2,722	2,722	2,722	2,706	2,659	2,613	2,569	2,722
4,000	2,722	2,722	2,722	2,700	2,651	2,604	2,558	2,514	2,471	2,722
5,000	2,722	2,697	2,646	2,597	2,550	2,504	2,460	2,418	2,377	2,693
6,000	2,644	2,593	2,544	2,497	2,451	2,408	2,365	2,324	2,285	2,607
7,000	2,541	2,492	2,445	2,400	2,356	2,314	2,273	2,234	2,196	2,523
8,000	2,441	2,394	2,349	2,305	2,263	2,223	2,184	2,146	2,110	2,441
9,000	2,344	2,299	2,256	2,214	2,174	2,135	2,097	2,061	2,026	2,361
10,000	2,251	2,207	2,166	2,125	2,087	2,049	2,014	1,979	1,945	2,282
11,000	2,160	2,118	2,078	2,040	2,003	1,967	1,932	1,899	1,867	2,206
12,000	2,072	2,032	1,993	1,957	1,921	1,887	1,853	1,821	1,791	2,131
13,000	1,986	1,948	1,911	1,876	1,842	1,809	1,777	1,747	1,717	2,058
14,000	1,904	1,867	1,832	1,798	1,765	1,734	1,703	1,674	1,646	1,987
15,000	1,824	1,789	1,755	1,723	1,691	1,661	1,632	1,604	1,576	1,918

PERFORMANCE DATA[DM8454]

August 10, 2012

Cross Reference

Engine Arrangement			
Arrangement Number	**Effective Serial Number**	**Engineering Model**	**Engineering Model Version**
2903313	MHB00001	PS017	-
3395408	KEN00001	PS017	-

Test Specification Data						
Test Spec	**Setting**	**Effective Serial Number**	**Engine Arrangement**	**Governor Type**	**Default Low Idle Speed**	**Default High Idle Speed**
0K8521	LL6011	MHB00001	2903313	ADEM3		
0K9250	LL6076	KEN00001	3395408	ADEM3		

Supplementary Data

Type	Classification	Performance Number
CONVERTIBLE SECONDARY FREQUENCY	50HZ	DM8754
SOUND	SOUND PRESSURE	DM8779

General Notes

General Notes DM8454 - 01
SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779

Performance Parameter Reference

Parameters Reference:DM9600-05

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600

APPLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request(SERR)test data shall be noted.

PERFORMANCE PARAMETER TOLERANCE FACTORS:

Power	+/- 3%
Torque	+/- 3%
Exhaust stack temperature	+/- 8%
Inlet airflow	+/- 5%
Intake manifold pressure-gage	+/- 10%
Exhaust flow	+/- 6%
Specific fuel consumption	+/- 3%
Fuel rate	+/- 5%
Heat rejection	+/- 5%
Heat rejection exhaust only	+/- 10%

Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.

On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.

These values do not apply to C280/3600. For these models, see the tolerances listed below.

C280/3600 HEAT REJECTION TOLERANCE FACTORS:

Heat rejection	+/- 10%
Heat rejection to Atmosphere	+/- 50%
Heat rejection to Lube Oil	+/- 20%
Heat rejection to Aftercooler	+/- 5%

TEST CELL TRANSDUCER TOLERANCE FACTORS:

Torque	+/- 0.5%
Speed	+/- 0.2%
Fuel flow	+/- 1.0%
Temperature	+/- 2.0 C degrees
Intake manifold pressure	+/- 0.1 kPa

OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE AIR AND FUEL CONDITIONS.

REFERENCE ATMOSPHERIC INLET AIR

FOR 3500 ENGINES AND SMALLER
SAE J1228 reference atmospheric pressure is 100 KPA (29.61 in hg) and standard temperature is 25 (77) at 60% relative humidity.

FOR 3600 ENGINES
Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JAN90 standard reference conditions of 25, 100 KPA 30% relative humidity and 150M altitude at the stated aftercooler water temperature.

MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE
Location for air temperature measurement air cleaner inlet at stabilized operating conditions.

PERFORMANCE DATA[DM8454]

REFERENCE EXHAUST STACK DIAMETER
The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available.

REFERENCE FUEL

DIESEL
Reference fuel is #2 distillate diesel with a 35API gravity; A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 29 (84.2), where the density is 838.9 G/Liter (7.001 Lbs/Gal).

GAS
Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas.

ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS EXTERNAL AUXILIARY LOAD
Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel out put power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators.

ALTITUDE CAPABILITY
Altitude capability is the maximum altitude above sea level at standar d temperature and standard pressure at which the engine could develop full rated output power on the current performance data set. Standard temperature values versus altitude could be seen on TM2001.

Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001. Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings.

REGULATIONS AND PRODUCT COMPLIANCE
TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative. Log on to the Technology and Solutions Divisions (T&SD) web page (http://tsd.cat.com/etsd/index.cfm?tech_id=2635ICAL) for information including federal regulation applicability and time lines for implementation. Information for labeling and tagging requirements is also provided.

NOTES:
Regulation watch covers regulations in effect and future regulation changes for world, federal, state and local. This page includes items on the watch list where a regulation change or product change might be pending and may need attention of the engine product group. For additional emissions information log on to the TMI web page.

Additional product information for specific market application is available.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

HEAT REJECTION DEFINITIONS:
Diesel Circuit Type and HHV Balance : DM9500

EMISSIONS DEFINITIONS:
Emissions : DM1176

PERFORMANCE DATA[DM8454]

SOUND DEFINITIONS:
Sound Power : DM8702

Sound Pressure : TM7080

RATING DEFINITIONS:
Agriculture : TM6008

Fire Pump : TM6009

Generator Set : TM6035

Generator (Gas) : TM6041

Industrial Diesel : TM6010

Industrial (Gas) : TM6040

Irrigation : TM5749

Locomotive : TM6037

Marine Auxiliary : TM6036

Marine Prop (Except 3600) : TM5747

Marine Prop (3600 only) : TM5748

MSHA : TM6042

Oil Field (Petroleum) : TM6011

Off-Highway Truck : TM6039

On-Highway Truck : TM6038

Date Released : 11/23/11

Sub-Appendix E – Terrain Data Sensitivity Analysis

1.21 INTRODUCTION

1.21.1 The dispersion model of emergency generator emissions was modelled with the assumption that the terrain between the source and the nearest receptors was relatively flat. This analysis provides the model output at a selection of air quality sensitive receptors with the influence of terrain. The terrain data used had a resolution of 50 m.

1.22 RESULTS

1.22.1 The results of the terrain data sensitivity analysis are provided in Table 14.3.17. The analysis focuses on predicted annual mean and hourly mean contributions of NO_X from the emergency generators (without any adjustment), assuming TBM from Braint.

1.22.2 The table demonstrates that there is generally limited variation in modelled predictions at the receptors likely to be most affected as a result of the use of terrain data, with the majority of predictions being within 10% of the maximum annual mean value, and within 20% of the maximum hourly mean value. The table also shows that the addition of terrain decrease the NO_X contribution at the majority of receptor locations considered.

Table 14.3.17: Analysis of Terrain Data Sensitivity – TBM from Braint

Receptor ID	Modelled Grid Reference		NO_X Contribution from Emergency Generators ($\mu g/m^3$)		
	X	Y	Without Terrain	With Terrain	Factor
Annual Mean[1]					
R5/07647	254972	368402	5.5	5.4	0.98
R5/07156	254409	368565	3.1	2.8	0.88
R5/07079	254311	368487	1.8	1.5	0.80
R5/07524	254887	368025	2.1	2.1	1.02
R5/07322	254757	368001	2.4	2.4	1.01
R5/06868	253923	368365	1.1	1.2	1.07
R5/07577	254915	368854	6.7	7.3	1.09

Table 14.3.17: Analysis of Terrain Data Sensitivity – TBM from Braint					
Receptor ID	Modelled Grid Reference		NO_X Contribution from Emergency Generators ($\mu g/m^3$)		
	X	Y	Without Terrain	With Terrain	Factor
R5/08346	255257	368362	2.5	2.7	1.06
R5/08574	255296	367998	1.3	1.3	1.00
R5/07236	254614	367869	2.0	1.8	0.92
R5/06922	254033	367777	2.4	2.1	0.87
R5/02987	251881	371161	67.0	66.8	1.00
R5/02815	251334	370703	13.7	13.5	0.99
R5/02725	251064	371379	1.4	1.3	0.95
R5/03425	252216	371121	11.9	11.6	0.98
R5/03755	252432	370927	5.3	5.7	1.06
R5/03134	252023	371437	21.6	21.3	0.99
R5/03460	252270	371693	9.4	9.4	1.00
R5/02878	251642	370384	4.3	4.0	0.91
R5/02641	250640	371023	1.1	1.3	1.24
R5/02917	251806	371947	5.8	6.1	1.04
Hourly Mean[2]					
R5/07647	254972	368402	8.6	7.5	0.88
R5/07156	254409	368565	9.2	7.6	0.81
R5/07079	254311	368487	8.8	9.0	1.03
R5/07524	254887	368025	8.1	6.5	0.81
R5/07322	254757	368001	7.4	7.4	1.00
R5/06868	253923	368365	10.5	11.3	1.08
R5/07577	254915	368854	8.5	7.4	0.87
R5/08346	255257	368362	7.8	7.0	0.91
R5/08574	255296	367998	7.2	6.7	0.93
R5/07236	254614	367869	8.4	8.6	1.01
R5/06922	254033	367777	7.9	6.7	0.84
R5/02987	251881	371161	136.0	139.2	0.99
R5/02815	251334	370703	59.6	57.8	0.99
R5/02725	251064	371379	25.2	23.1	0.94

Table 14.3.17: Analysis of Terrain Data Sensitivity – TBM from Braint					
Receptor ID	Modelled Grid Reference		NO_X Contribution from Emergency Generators ($\mu g/m^3$)		
	X	Y	Without Terrain	With Terrain	Factor
R5/03425	252216	371121	56.5	52.4	0.93
R5/03755	252432	370927	47.7	38.6	0.81
R5/03134	252023	371437	54.7	54.7	1.02
R5/03460	252270	371693	35.6	37.8	1.08
R5/02878	251642	370384	39.4	37.7	0.92
R5/02641	250640	371023	18.5	31.4	1.73
R5/02917	251806	371947	36.7	35.1	0.97

[1] Not factored for hours of operation.

[2] Assuming one generator tested at each construction compound at any one time.