ONE HOUSING GROUP
BANGOR WHARF, GEORGINA STREET,
CAMDEN, LONDON

AIR QUALITY ADDENDUM

JUNE 2017

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Air Quality Addendum

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1 Introduction

1.1 This Air Quality Addendum Assessment has been produced in order to complement the air quality assessment submitted as part of the planning application for a proposed mixed-use development of land off Georgiana Street, Camden (known as Bangor Wharf – The Site)

1.2 The following air quality addendum provides some additional information, which was not available at the time the original assessment was prepared, in relations to the proposed energy strategy and associated emissions.

1.3 The main additional information contained herein comprises of detailed dispersion modelling of emissions associated with the proposed energy centre (EC), in response to queries raised London Borough of Camden's Environmental Health Department.

1.4 All other works and findings within the original Air Quality Assessment, dated February 2017, remain unchanged and therefore not covered here.

2 Dispersion Modelling of Energy Centre

2.1 A dispersion modelling exercise has been undertaken for the proposed Energy Centre (EC) in order to identify whether it is possible to detect any emissions associated with its plume dispersion either in the local area, or further afield. The proposed EC will comprise of one Low NOx emission CHP (SAV XRGI9) with Selective Catalytic Reduction and two low NOx boilers (Hoval Ultragas 1150D).

2.2 The technical/emissions specifications of these plant have been provided by the project building engineers and individual manufactures. These are provided in **Appendix A.**

2.3 As noted in Section 7 of the original Air Quality Assessment (Air Quality Neutral Assessment), the emission rates associated with both the CHP and the boilers are below the guideline values set within the Sustainable Design and Construction Supplementary Planning Guidance (SDCSPG).

2.4 This additional study was commissioned following queries raised by London Borough of Camden's Environmental Health Department in relation to NO_x emissions.

Modelling Tool

2.5 The modelling tool which has been used is the dispersion model ADMS-Roads Extra, which has been developed by the Cambridge Environmental Research Consultants and can be used to model point source emissions. ADMS-Roads Extra is particularly suitable for modelling situations where the point source is in close proximity to significant building mass and where there is a potential that the emission plume may be grounded prematurely by the adjacent buildings i.e. subject to the 'building downwash' effect.

2.6 This model uses the following input data:

- NOx Emission rates (g/s);
- Specific heat capacity of whole release (^{o}C/kg);
- Molecular mass of whole release (g);
- Density of whole release(kg.m^{3});
- Stack Heights (m);
- Flue diameter (m);
- Vertical velocity of release (m/s);
- Temperature of release (^{o}C)
- Stack coordinates;

- Geo-referenced mapping data; and
- Hourly Sequential ADMS format MET data for the closest suitable site of Heathrow, for the year 2016; and
- Site building height and massing for assessment of building downwash.

2.7 A list of all the modelling data used during this exercise is set out in **Appendix B.**

Model Parameters

2.8 The following provides a discussion of some of the parameters applied within the dispersion model.

Meteorological Data

2.9 The meteorological data applied within the ADMS-Roads Extra model was obtained from a representative location to the Site and included for full year of sequential readings. The MET office advised that the closest suitable site with the most representative data was located at Heathrow.

2.10 The met data was obtained for 3 consecutive years, 2014, 2015 and 2016. Following an initial set of model runs, 2016 was identified as the worst-case scenario (recording the highest emission levels at sensitive receptor locations) and therefore has been used to represent the final results in this report. The relevant wind rose data for this location for 2016 is set out in **Appendix C.**

Receptor Locations

2.11 Pollutant dispersion modelling has been undertaken specifically for NO_x/NO_2 for the following receptors/environments:

Central amenity areas/spaces at ground level

2.12 These areas have been chosen in order to represent those locations where existing or proposed residents may be expected to spend leisure time for extended periods. Detection of EC emissions has been examined at heights of 1.5m from ground level (Coutyard-1 and Coutyard-2) . The location of the receptors examined is set out in **Figure 2.1**

Figure 2.1: EC Assessment Locations: Central Amenity Areas/Spaces at ground Level

Inner facades at successive storey heights

2.13 Balconies within the central courtyard areas are also considered as 'amenity space'. Therefore, detection of EC emissions has also been undertaken for each inner façade at successive storey heights. Three vertical axis have been examined and these are illustrated in **Figure 2.2**.

2.14 In addition, receptors located at 1.5m above every floor's ground level have been examined, both within the central courtyard and the closest resident buildings outside the development. The location of the receptors examined is set out in **Figure 2.2** and the different heights are set up on **Table 2.1**

Figure 5.2: EC Assessment Locations: Inner Facades at Successive Storey Heights

Receptor ID	X	Y	Height over modelled GL (m)	Floor	Height AOD (m)
Courtyard-1	529347	184031	1.5	Ground	26.8
Coutyard-2	529339	184022	1.5	Ground	26.8
BlockA1-1F	529335	184007	5.7	First	31
BlockA1-2F	529335	184007	8.7	Second	34
BlockA2-1F	529343	184013	5.7	First	31
BlockA2-4F	529343	184013	14.7	Fourth	40
BlockB-4F	529347	184017	14.7	Fourth	40
BlockC-4F	529334	184029	13.2	Fourth	38.5
BlockC-5F	529334	184029	16.4	Fifth	41.7
Bld-118	529325	183995	9	Rooftop	34.3
Bld-122	529319	184005	9	Rooftop	34.3
Bld-124	529319	184005	9	Roofto	34.3

Table 2.1: EC Assessment Locations

Wider local area (up to 6km^2).

2.15 Point source emissions are understood to form buoyant 'plumes' which, dependent upon the rate and temperature of emission, diameter and height of stack, can travel significant distances before dispersing. In some cases, local topography and meteorology can cause a plume to 'ground' i.e. reach ground level, before becoming sufficiently dispersed. Therefore, an assessment has also been applied across a grid of 6km2 in order to examine the likelihood of this occurrence. The area examined is illustrated in **Figure 2.3.**

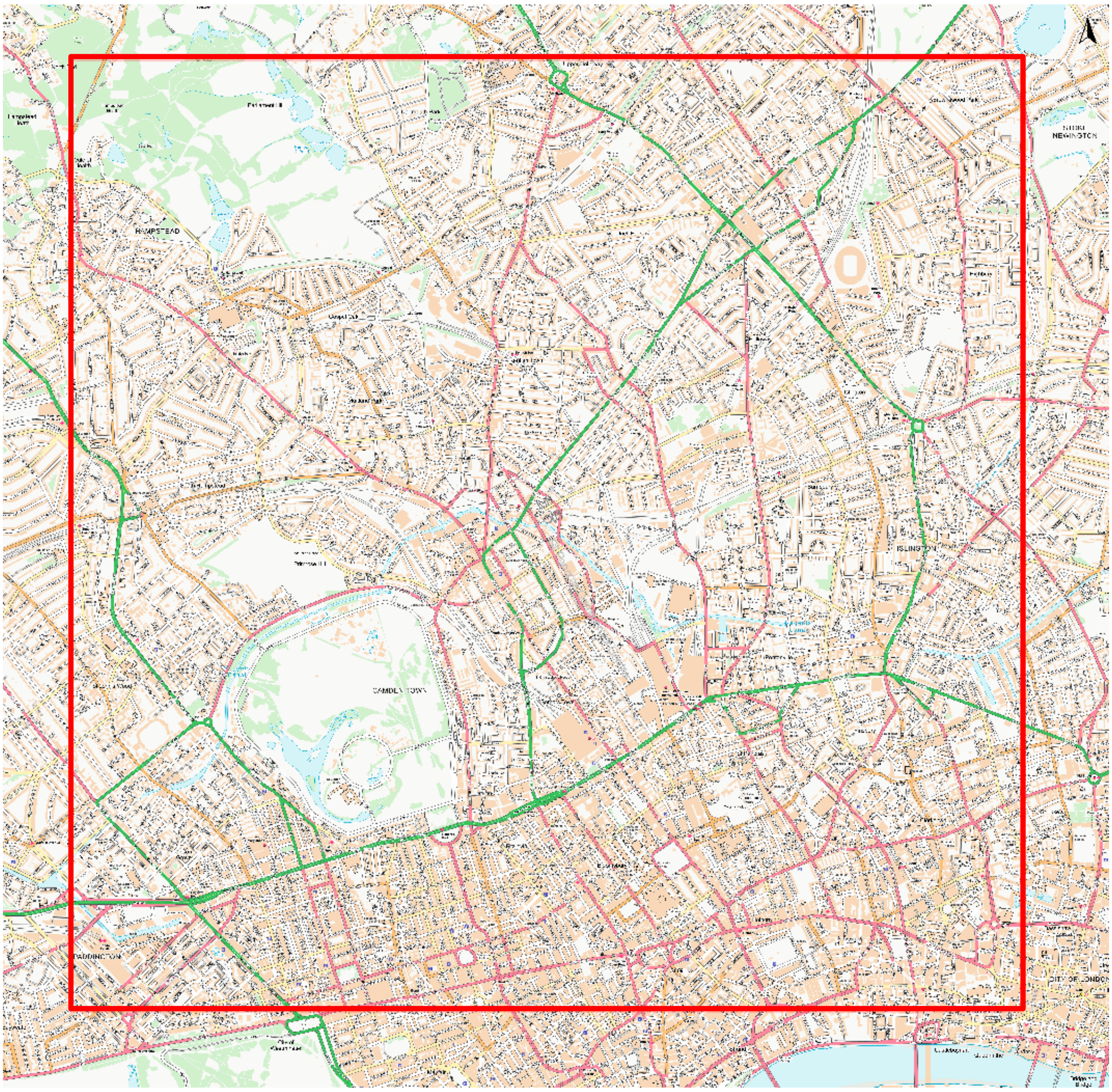

Figure 2.3: EC Assessment Locations: Wider Local Area (6km^2)

Model Uncertainty.

2.16 The modelling process is dependant in the first instance upon input data. Where this data is subject to change, this may affect the results of the modelling process.

2.17 Model uncertainty can result from:

- Model formulations;
- Data uncertainty – due to errors in input data emission estimates and background estimates and meteorology; and
- Variability – randomness of measures used.

2.18 Model uncertainty as a result of data uncertainty has been reduced where possible by close verification of the input data.

2.19 It is noted within the IAQM Air Quality Planning Guidance[1] that model verification of point source emissions is not practicable therefore a number of sensitivity tests have been conducted on the input data. These have included examination of the effects of:

- Adjustment of stack heights;
- Adjustment of emission rates;
- Adjustment of flue location;
- Adjustment of receptor locations and grid spacings; and
- Adjustment of ground heights

2.20 All of the above tests have provided confidence that the model is responding as expected.

Assessment of Effects

2.21 Table 2.1 in the air quality assessment which was submitted to support the original application, provides the national health based air quality standards and objectives as set out within the Air Quality Strategy and which are used in the assessment of effects. The EPUK & IAQM Air Quality Planning Guidance notes that, with regards to point source emissions, the impacts resulting from short term, peak concentrations of those pollutants that can affect health through inhalation are of most concern. It notes that the Environment Agency uses a threshold criterion of 10% of the short-term Air Quality

[1] Environmental Protection UK & Institute of Air Quality Management (EPUK & IAQM) (2015) Land-Use Planning & Development Control: Planning for Air Quality, EPUK & IAQM, London

Action Level as a screening criterion for the maximum short-term impact. It concludes that this is a reasonable value to take and adopts it as a basis for defining an impact that is sufficiently small in magnitude to be regarded as having an insignificant effect.

2.22 The short-term Air Quality Action Level for NO_2 is 200 µg/m^3. This has been modelled as the 99.79th percentile of the short term annual mean. In accordance with the guidance issued by EPUK, IAQM and the Environment Agency, any short-term concentrations associated with the emissions from the EC which are of 20 µg/m^3 or less, will be considered negligible and therefore insignificant.

Results

2.23 The findings of the exercise to detect emissions from the EC within the identified different environments is set out below.

Central Amenity Areas & Nearest Residential Buildings

Receptor Location	Modelled Short -term NO_2 Concentrations (99.79th percentile) (µg m^{-3})
Courtyard-1	3.97
Coutyard-2	3.96
BlockA1-1F	5.66
BlockA1-2F	5.66
BlockA2-1F	5.66
BlockA2-4F	5.66
BlockB-4F	4.20
BlockC-4F	3.62
BlockC-5F	17.39
Bld-118	3.94
Bld-122	3.96
Bld-124	3.96

Table 2.2: EC Assessment Locations: Central Amenity Areas & Nearest Residential Buildings

2.24 This demonstrates that the modelled short term NO_2 concentrations, as a result of the EC, are is less than 20 µg/m^3. Therefore, in line with the EPUK & IAQM Air Quality Planning Guidance, the effect of the EC on levels of NO_2 within the amenity space and nearest residential buildings is considered negligible and therefore insignificant.

Inner facades at successive storey heights

2.25 Figures 2.4, 2.5 and 2.6 illustrate the change in NO_2 concentration with height at façade

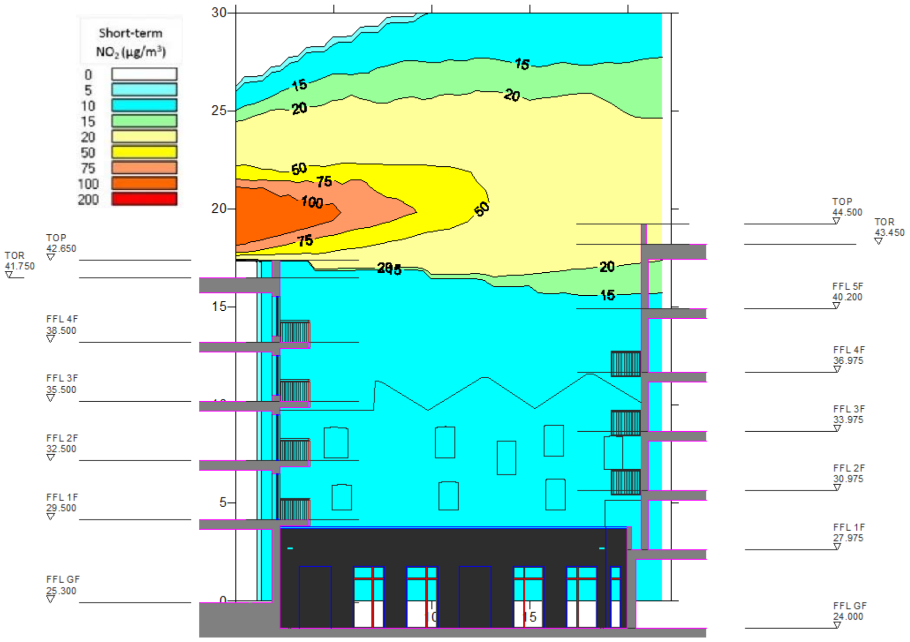

Figure 2.4: EC Assessment Locations: Inner Facades, Courtyard Elevation E6

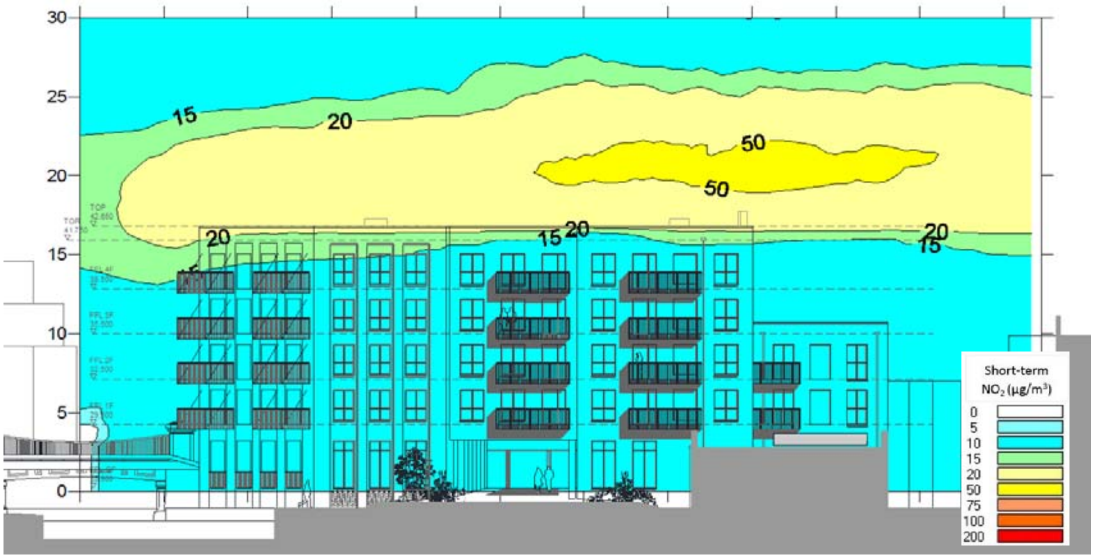

Figure 2.5: EC Assessment Locations: Inner Facades, Courtyard Elevation E7

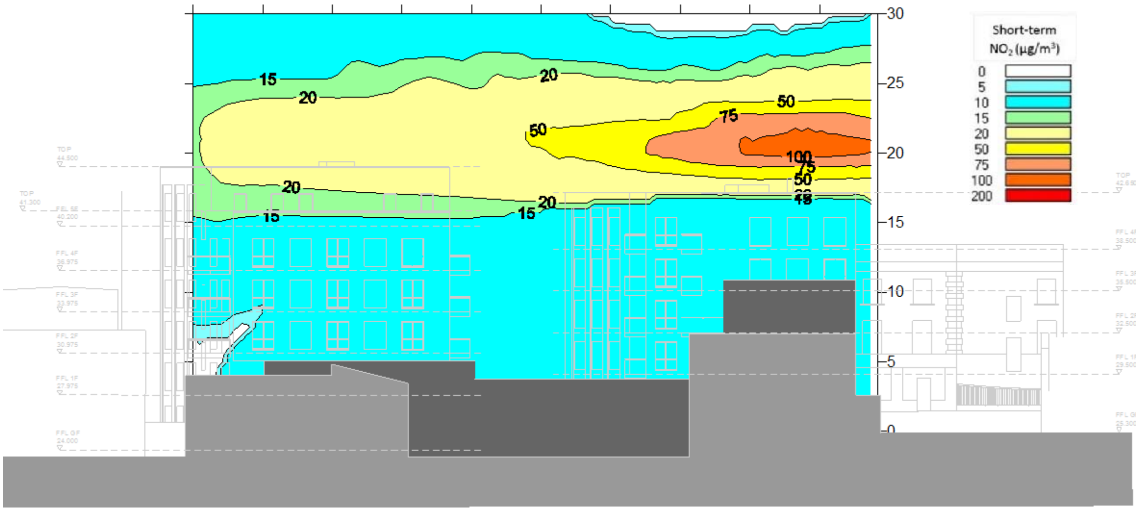

Figure 2.6: EC Assessment Locations: South West Facing Elevation. E9

2.26 The above images illustrate that short term NO_2 concentrations are less than 20 µg/m^3 at the balcony/window levels of the inner facades and the residential buildings near the development, as a result of the EC emissions. Therefore, in line with n line with the EPUK & IAQM Air Quality Planning Guidance, the effect of the EC on levels of NO_2 at the balcony areas is considered negligible and therefore insignificant.

Wider local area (up to 6km^2).

2.27 Figure 2.7 below illustrates the NO_2 plume associated with the EC over a 6km^2 area.

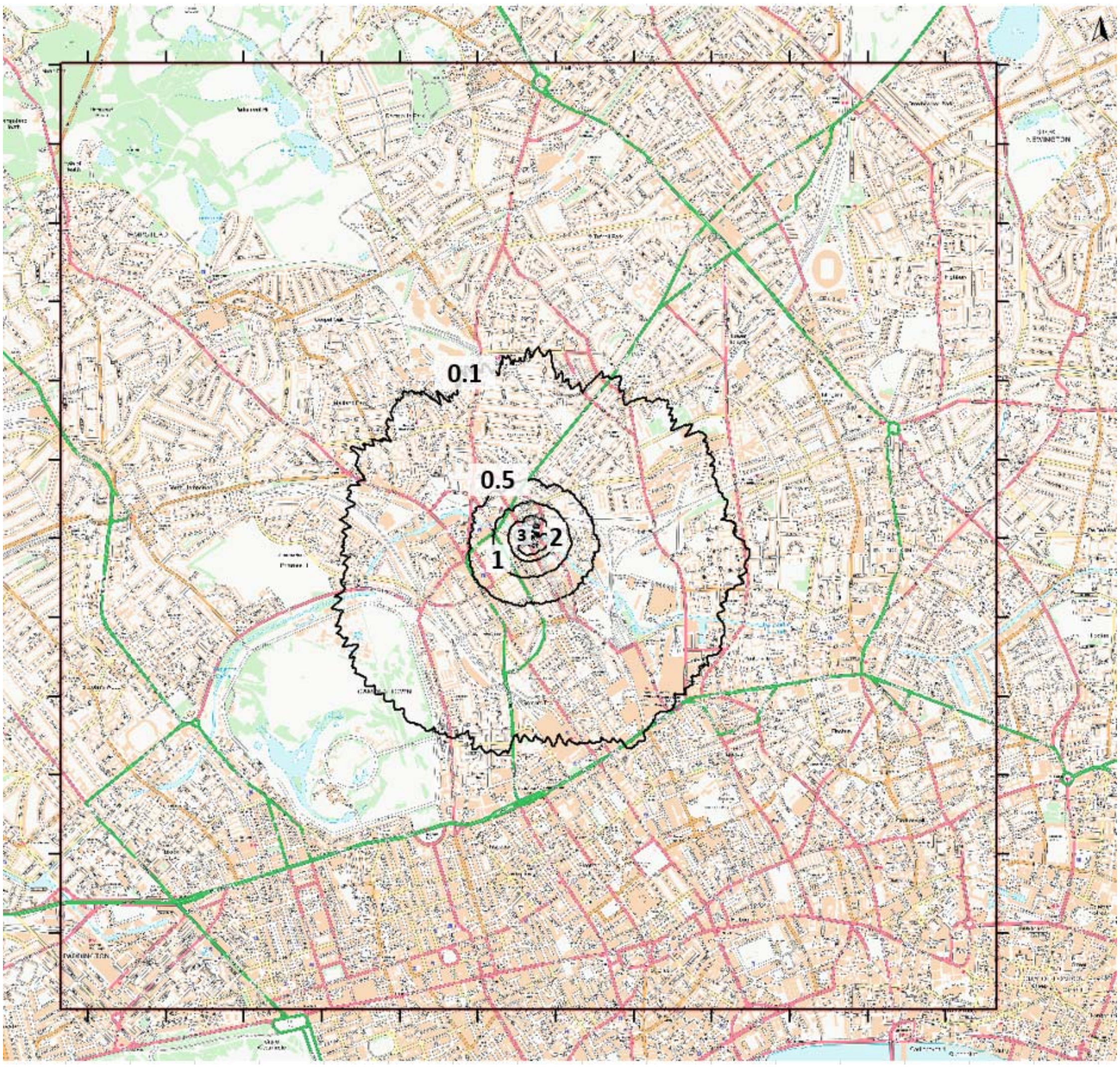

Figure 2.7: Estimated EC NO_2 Concentrations over $6km^2$ at 1.5m over GL

2.28 This images illustrates that the short term NO_2 concentrations at ground level across a $6km^2$ as a result of the EC, are considerably less than 20 µg/m^3. Therefore, Therefore, in line with n line with the EPUK & IAQM Air Quality Planning Guidance, the effect of the EC on levels of NO_2 are also considered negligible and therefore insignificant.

3 Summary & Conclusions

3.1 Dispersion modelling of the proposed Energy Centre has been undertaken based upon data provided by the project architects and building engineers. This has sought to establish whether any significant emissions from the plant can be detected within the central amenity spaces, at balcony and window levels and within the wider local area. The study has concluded that any emissions associated with the EC are considered to be sufficiently small in magnitude to be regarded as having an insignificant effect, in accordance with current guidance.

3.2 As discussed in the original assessment it is not considered that the proposed Energy Centre at the Bangor Wharf site will raise any significant or other adverse air quality impacts on the health and quality of life of existing and proposed sensitive receptors or have any material impacts upon existing air quality levels.

3.3 It is therefore concluded that the proposed development complies fully with air quality related national, regional and local planning policy and should not be refused on air quality grounds.

Appendix A

CHP and Boilers Technical Specifications

Technical Data

UltraGas® (800D-1300D)

Type			(800D)	(900D)	(1000D)	(1150D)	(1300D)
• Nominal output 80/ 60 °C with natural gas		kW	87 - 742	87 - 834	87 - 926	122 - 1066	122 - 1206
• Nominal output 40/ 30 °C with natural gas		kW	97 - 800	97 - 900	97 - 1000	136 - 1150	136 - 1300
• Nominal output 80/ 60 °C with liquid gas [1]		kW	139 - 728	139 - 820	139 - 910	169 - 1048	169 - 1184
• Nominal output 40/ 30 °C with liquid gas [1]		kW	154 - 800	154 - 900	154 - 1000	185 - 1150	185 - 1300
• Heat input net CV basis with natural gas		kW	89 - 754	89 - 848	89 - 942	125 - 1084	125 - 1226
• Heat input net CV basis with liquid gas [1]		kW	144 - 754	144 - 848	144 - 942	175 - 1084	175 - 1228
• Working pressure heating max./min. [2]		bar	6.0 / 1.2	6.0 / 1.2	6.0 / 1.2	6.0 / 1.2	6.0 / 1.2
• Working temperature max.		°C	90	90	90	90	90
• Boiler water content		l	822	774	751	1098	1058
• Minimum water flow rate [3]		l/h	0	0	0	0	0
• Boiler weight (without water content, incl. casing)		kg	1806	1910	1962	2566	2656
• Boiler efficiency Part load 30% at 50/30°C (gross)		%	97.4	97.4	97.3	97.4	97.3
• Boiler efficiency Full load 100% at 80/60°C (gross)		%	88.6	88.6	88.6	88.6	88.6
• Part L UK Seasonal efficiency		%	95.7	95.7	95.6	95.7	95.6
• Stand-by loss at 70 °C		Watt	1500	1500	1500	2000	2000
• Emission rate	Nitrogen oxides [4]	mg/kWh	37	37	37	36	39
	Carbon monoxide	mg/kWh	17	17	22	17	17
• Content of CO_2 in the exhaust gas maximum/minimum output		%	9.0 / 8.8	9.0 / 8.8	9.0 / 8.8	9.0 / 8.8	9.0 / 8.8
• Dimensions			See table of dimensions				
• Connections	Flow/return	DN	DN125/PN6	DN125/PN6	DN125/PN6	DN150/PN6	DN150/PN6
	Gas x2	Inches	2"	2"	2"	2"	2"
	Flue gas Ø inside	mm	356	356	356	356	356
• Gas flow pressure minimum/maximum							
Natural gas E		mbar	15-80	15-80	15-80	15-80	15-80
Propane gas		mbar	37-57	37-57	37-57	37-57	37-57
• Gas connection value at 0 °C / 1013 mbar:							
Natural gas E - (Wo = 15,0 kWh/m³) H_u = 9,97 kWh/m³		m³/h	75.4	84.9	94.3	108.5	122.7
Propane gas (H_u = 32,7 kWh/m³)		m³/h	29.1	32.7	36.4	41.9	47.3
• Operation voltage		V/Hz	230/50	230/50	230/50	230/50	230/50
• Control voltage		V/Hz	24/50	24/50	24/50	24/50	24/50
• Minimum/maximum electrical power consumption		Watt	60/890	60/1164	60/1490	62/1440	62/2060
• Stand-by		Watt	24	24	24	24	24
• IP rating (integral protection)		IP	20	20	20	20	20
• Acoustic power level max		dB(A)	74	76	78	75	78
• Acoustic pressure level at 1 metre		dB(A)	64	66	68	65	68
• Condensate quantity (natural gas) at 40/ 30 °C		l/h	70.9	79.7	88.5	101.9	115.2
• pH value of the condensate		pH	ca. 4.2	ca. 4.2	ca. 4.2	ca. 4.2	ca. 4.2
• Values for flue calculation:							
Temperature class			T120	T120	T120	T120	T120
Flue gas mass flow		kg/h	1252	1408	1564	1799	2035
Flue gas temperature with operating conditions 80/ 60 °C		°C	71	71	72	71	72
Flue gas temperature with operating conditions 40/ 30 °C		°C	48	47	49	47	49
Volume flow rate combustion air		Nm³/h	933	1050	1166	1342	1518
Usable overpressure for air duct/flue system		Pa	60	60	60	60	60

[1] UltraGas (800D-1300D) can also be operated with propane/butane (liquid gas) mixtures.
[2] Boiler test pressure is 1.5 times max. operating pressure.
[3] Although generally the UltraGas boilers do not require a minimum water flow, it does not mean that the pump and burner can be switched off together when the unit is operating at full output. There should be a pump overrun to dissipate any residual heat within the boiler to avoid nuisance high temperature lockouts.
[4] NOx emissions to EN676 are dry and at 0% excess oxygen.

• Boiler flow resistance see separate page.

• Note, from a controls point of view UltraGas D boilers are seen as two units. This means that each unit will require its own power supply and controls signals.

XRGI-9 NO_x Emissions Data Sheet

Summary

Heat Related NO_x	Assessment In- put Value
- 325 mg/kWh @ 0% O_2	**0 mg/kWh @ 0% O_2**

Calculation

Total NO_x emissions 100 mg/m^3 @ 5% O_2 (manufacturer data)

1. Conversion to mg/kWh factor = 0.857

100 mg/m^3 @ 5% O_2 x 0.857 = 86 mg/kWh @ 5% O_2

2. Excess Oxygen Correction Calculation = 20.9 / (20.9 - X)

% O_2 in air = 20.9

X = % Excess O_2 = 5

20.9 / (20.9 - 5) = 1.3144

86 mg/kWh @ 5% O_2 x 1.3144 = 113 mg/kWh @ 0% O_2

NO_x emission calculation; X = (A-B)/C

X = NO_x emission per unit of heat supplied

A = NO_x emission per unit of electricity generated by CHP = Total NO_x x Electrical Generation %

Electrical Generation % = Electrical output / Total output = 9 / (9 + 20) = 0.31

113 mg/kWh @ 0% O_2 x 0.31 = 35 mg/kWh @ 0% O_2

B = NO_x emission per unit of electricity generated by grid (mg/kWh) = 750 mg/kWh (national value)

C = Heat to electricity ratio = 20/9 = 2.2 (manufacturer data)

X = (35 – 750) / 2.2 = - 325 mg/kWh

X = - 325 mg/kWh

As the heat related dry NO_x value calculated here is negative, it can be assumed to be zero for assessments. Please see the calculation notes over leaf for further information.

Issued: 19/12/2013

NO_x Calculation Notes

When discussing NO_x emissions from CHP, it is only the heat related NO_x emissions that need to be considered. Manufacturers typically supply total NO_x values, which need to be allocated to heat and electricity in line with the respective power outputs. The following formula must be used to determine this:

X = (A – B)/C

Where:
X = NO_x emissions per unit of heat supplied (mg/kWh)

A = NO_x emissions per unit of electricity generated (mg/kWh) Note: This is the NO_x emitted by the CHP system per unit of electricity generated and should be obtained from the supplier. Where data is provided in different units or at a level of excess oxygen above zero it must be corrected using the factors above.

B = NO_x emissions per unit of electricity supplied from the grid (mg/kWh).
Note: this should be assumed to be 750mg/kWh supplied
C = Heat to Electricity Ratio of the CHP scheme

Calculations for The Code for Sustainable Homes and/or BREEAM ratings require dry NO_x values to be used. Dry NO_x is the NO_x emissions (mg/kWh) resulting from the combustion of a fuel at zero per cent excess oxygen levels.

Where the heat related dry NO_x value is calculated to be negative, it should be assumed to be zero for these assessments.

Appendix B

Dispersion Model Data

Parameter	Notes
Emission rate - CHP	0.000 g/s
Emission rate – Boilers	0.012 g/s
Specific heat capacity of whole release	1012 $^{o}C/kg$
Molecular mass	28.966 g
Density	1.225 kg/m^3
Flue Height	18.35m (43.65 AOD)
Modelled Flue location - CHP	529341.7, 184004.9
Modelled Flue location - Boilers	529341.3, 184004.8
Diameter – CHP	0.08m
Diameter - Boilers	0.375m (combined for modelling purposes)
Vertical velocity of release – CHP	4.8 m/s
Vertical velocity of release - Boilers	5.0 m/s
Temperature of release - CHP	120 ^{o}C
Temperature of release – Boilers	65
Met Data	Heathrow 2016
Surface roughness Heathrow	0.2 (as advised)
Surface roughness Site	1
Receptor Height (at ground)	1.5m
Model Output	Short term NO_x (1hr) as 99.79th percentile converted[2] to NO_2 (1hr)
Ground Level	Modelled as 25.3 AOD
Model Output	Short term NO_x (1hr) as 99.79th percentile converted[3] to NO_2 (1hr)

[2] Conversion based upon of Defra 1km^2 NOx/NO_2 data for London Borough of Camden.
[3] Conversion based upon of Defra 1km^2 NOx/NO_2 data for London Borough of Camden.

Appendix B

Heathrow Wind Rose

Heathrow Wind Rose (2016)