




Caring for the environment and creating safer workplaces

Report for the Periodic Monitoring of Emissions to Atmosphere

Wyndeham Heron Ltd

Operator:	Wyndeham Heron Ltd
Permit Number:	MLD/EPR/A2/001
Installation:	Printworks
Monitoring Dates:	5 th & 6 th December 2013
Site Address:	The Bethnal Complex Colchester Road Maldon CM9 4NW

Report Number:	J 5875
Version:	1
Date of Report:	20 th December 2013
Report Author:	Mr D Sharples
MCERTS Registration N°:	MM 12 1184
MCERTS Level:	Level 1 (TE4)

Report Approved by:	Mr A R May
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MCERTS Level:	MCERTS Level 2 (TE1, TE3, TE4)
Function:	Sales & Operations Manager
Signed:	

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Part 1: Executive Summary

1.1 Monitoring Objectives

Wyndeham Heron operate several printing lines that have the potential to release controlled substances to atmosphere, and are subject to authorisation under the Environmental Permitting Regulations (EPR, 2010). Under the act, Local Authorities regulate the printing processes with guidance from the Sector Guidance Note SG6: Surface Treatment using Solvents.

In order for Wyndeham Heron to comply with its annual emission limits they have requested that Envirocare Technical Consultancy undertake a monitoring exercise on all of the thermal oxidiser abatement units and from the waste transport system compactor. The methodologies and results obtained form the basis of this report.

The two Rotoman presses have two print lines that run simultaneously and are located one above the other, each press has its own dryer, each with a duct exiting the dryer and emitting vertically alongside one another. The Lithoman 1 Press has a dedicated dryer.

Emission Point Identification

Substances to Be Monitored	Rotoman 2		Rotoman 3		Lithoman 1	Compactor
	Lower	Upper	Lower	Upper		
CO	✓	✓	✓	✓	✓	
NOx	✓	✓	✓	✓	✓	
VOCs	✓	✓	✓	✓	✓	
Moisture (for correction)	✓	✓	✓	✓	✓	
Total Particulate Matter						✓
Special requirements	None					

Opinions and interpretations expressed within this report are outside the scope of Envirocare Technical Consultancy's MCERTS and UKAS accreditation.

1.2 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 2 Lower	Carbon Monoxide	100	49.0	mg/Nm ³	4.6	273K, 101.3kPa, WET	05/12/13	16:04-17:15	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO _x)	100	50.5	mg/Nm ³	1.9	273K, 101.3kPa, WET	05/12/13	16:04-17:15	BS EN 14792	MCERTS	Normal
	Total VOC's	20	0.6	mg/Nm ³	1.3	273K, 101.3kPa, WET	05/12/13	16:04-17:15	BS EN 12619	MCERTS	Normal
	Moisture Content	None	0.0	%	-	273K, 101.3kPa	05/12/13	15:58-16:30	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	3601.9	Nm ³ /Hr	-	273K, 101.3kPa	05/12/13	~14:30	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 2 Upper	Carbon Monoxide	100	52.2	mg/Nm ³	4.6	273K, 101.3kPa, WET	05/12/13	14:48-15:54	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO _x)	100	67.4	mg/Nm ³	2.3	273K, 101.3kPa, WET	05/12/13	14:48-15:54	BS EN 14792	MCERTS	Normal
	Total VOC's	20	1.8	mg/Nm ³	2.5	273K, 101.3kPa, WET	05/12/13	14:48-15:54	BS EN 12619	MCERTS	Normal
	Moisture Content	None	0.0	%	-	273K, 101.3kPa	05/12/13	14:44-15:22	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	4191.0	Nm ³ /Hr	-	273K, 101.3kPa	05/12/13	~16:00	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 3 Lower	Carbon Monoxide	100	39.0	mg/Nm ³	4.8	273K, 101.3kPa, WET	05/12/13	09:45-09:53; 10:02-10:25; 11:16-12:16	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO _x)	100	74.9	mg/Nm ³	2.4	273K, 101.3kPa, WET	05/12/13	09:45-09:53; 10:02-10:25; 11:16-12:16	BS EN 14792	MCERTS	Normal
	Total VOC's	20	4.5	mg/Nm ³	4.3	273K, 101.3kPa, WET	05/12/13	09:45-09:53; 10:02-10:25; 11:16-12:16	BS EN 12619	MCERTS	Normal
	Moisture Content	None	0.6	%	-	273K, 101.3kPa	05/12/13	11:26-11:58	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	4258.6	Nm ³ /Hr	-	273K, 101.3kPa	05/12/13	~10:40	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Rotoman 3 Upper	Carbon Monoxide	100	39.5	mg/Nm ³	4.8	273K, 101.3kPa, WET	05/12/13	12:23-12:45; 13:26-14:40	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO _x)	100	71.1	mg/Nm ³	2.3	273K, 101.3kPa, WET	05/12/13	12:23-12:45; 13:26-14:40	BS EN 14792	MCERTS	Normal
	Total VOC's	20	6.1	mg/Nm ³	4.3	273K, 101.3kPa, WET	05/12/13	12:23-12:45; 13:26-14:40	BS EN 12619	MCERTS	Normal
	Moisture Content	None	1.8	%	-	273K, 101.3kPa	05/12/13	12:28-13:11	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	3254.5	Nm ³ /Hr	-	273K, 101.3kPa	05/12/13	~12:15	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Lithoman 1	Carbon Monoxide	100	79.3	mg/Nm ³	3.9	273K, 101.3kPa, WET	06/12/13	10:33-11:52	BS EN 15058	MCERTS	Normal
	Oxides of Nitrogen (as NO _x)	100	37.0	mg/Nm ³	2.0	273K, 101.3kPa, WET	06/12/13	10:33-11:52	BS EN 14792	MCERTS	Normal
	Total VOC's	20	11.2	mg/Nm ³	2.5	273K, 101.3kPa, WET	06/12/13	10:33-11:52	BS EN 12619	MCERTS	Normal
	Moisture Content	None	1.4	%	-	273K, 101.3kPa	06/12/13	10:41-11:31	US EPA M4	ISO 17025	Normal
	Volumetric Flowrate	None	Could not be determined	Nm ³ /Hr	-	273K, 101.3kPa	06/12/13	~10:30	BS EN 13284	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty as % of ELV (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Compactor	Total Particulate Matter	50*	1.29	mg/Nm ³	-	273K, 101.3kPa	05/12/13	11:23-15:00	MDHS 14/3	None	Normal

*Assumed

1.3 Operating Information

Emission Point Reference	Date	Process Type	Process Duration	Fuel	Feedstock	Abatement	Press Speed	Comparison of Operator CEMS and Periodic Monitoring Results			
								Substance	CEMS Results	Periodic Monitoring Results	Units
Rotoman 2 Lower	05/12/13	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	43,000 cph	N/A	N/A	N/A	N/A
Rotoman 2 Upper	05/12/13	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	43,000 cph	N/A	N/A	N/A	N/A
Rotoman 3 Lower	05/12/13	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	42,000 cph	N/A	N/A	N/A	N/A
Rotoman 3 Upper	05/12/13	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	42,000 cph	N/A	N/A	N/A	N/A
Lithoman 1	06/12/13	Offset Lithographic Printing	Batch.	Natural Gas	Paper and Ink	Thermal Oxidiser	28,000 cph	N/A	N/A	N/A	N/A
Compactor	05/12/13	Collection of offcuts from binding	Continuous	None	Paper offcuts	Bag Filter	N/A	N/A	N/A	N/A	N/A

1.4 Monitoring Deviations

Emission Point Reference	Substance Deviations	Monitoring Deviations	Other Relevant Issues
Rotoman 2 Lower	None	None	None
Rotoman 2 Upper	None	None	None
Rotoman 3 Lower	None	None	None
Rotoman 3 Upper	None	None	None
Lithoman 1	None	Flows not measured due equipment malfunction	None
Compactor	None	None	None

Part 2: Supporting Information

2.1 Appendix 1: General Information

2.1.1 Monitoring organisation staff details

Personnel	Function in monitoring campaign	MCERTS Level	MCERTS Number
Mr A R May	Team Leader	MCERTS Level 2 (TE1, TE3, TE4)	MM 05 626
Mr L Oddy	Technician	MCERTS Trainee	MM13 1228
Mr R Dyson	Technician	MCERTS Trainee	MM131229

2.1.2 Monitoring Methods

Pollutant Species	Standard	Technique	Envirocare Internal Procedure
Total VOC's	BS EN 12619	FID	ETC-M-03
Carbon Monoxide	BS EN 15058	NDIR	ETC-M-25
Oxides of Nitrogen	BS EN 14792	Chemiluminescence	ETC-M-25
Particulates	MDHS 14/3	Gravimetric	SM-05
Stack Temperature + Velocity	BS EN 13284	Pitot Tube + Thermocouple	ETC-M-46

2.1.3 Equipment Checklist

Equipment ID	Model Number	Purpose
Horiba 2	Horiba PG250	Multi component gas analyser
Sig 1	Signal 3030pm	Flame Ionisation Detector
HL3	Signal Heated Line	PTFE Cored heated sample line
HL9	-	PTFE Cored heated sample line
GPU2	Testo 339	Heated line controller and sample gas conditioner
THL5	-	PTFE Cored heated sample line

2.2 Appendix 2: Rotoman 2 (Lower) Results and Calculations

2.2.1 Photograph of the sampling location and positions



2.2.2 Flow criteria measurements

DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 2 Lower** Date: **05/12/2013**
 Duct dimensions: **50.0 cm**
 Local barometric pressure: **1016 mbar**
 Ambient Temperature: **30 °C** Pitot Coefficient = **0.822**
 Micromanometer Calibration (K; mbar) = **289 1000**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.5	10.8	12.9	347
	A2	0.15	7.5	11.1	13.3	347
	A3	0.25	12.5	10.8	12.9	347
	A4	0.35	17.5	9.9	11.8	347
	A5	0.45	22.5	10.0	11.9	347
	A6	0.55	27.5	9.7	11.6	347
	A7	0.65	32.5	8.9	10.6	347
	A8	0.75	37.5	9.0	10.8	347
	A9	0.85	42.5	8.3	9.9	347
	A10	0.95	47.5	8.1	9.7	347

<u>Velocity readings (m/s)</u>			
Duct Mean m/s		11.5	
Highest(a)	13.3	Lowest (b)	9.7

<u>Temperature readings</u>			
Duct Mean °C		347	
Duct Mean K 620			
Highest(a)	347.0	Lowest (b)	347.0

<u>Volumetric flow rate</u>			
Duct dimensions	50.0	(cm)	
Duct area	0.196	(m ²)	
Mean duct velocity	11.5	(m/s)	
Mean duct temperature	347	(°C)	
Ambient pressure	1016	(mbar)	
Vol. Flow rate at stack conditions	8156	(m³/hr)	
Vol flow rate corrd.	3601.9	(Nm³/hr)	

2.2.3 Water vapour measurements

MOISTURE TEST FORM

Client Name: Wyndeham Heron
Job Number: 5875

Date: 05/12/2013

Stack Reference:

Ambient Pressure (mbar): 1016
Stack Temperature (°C): 357
Gasmeter Coefficient: 1.000
Equipment used:
Leak Check (l/min) Before: 0
After: 0

Gas Meter Temperature (°C):

Start: 18
End: 22
Mean: 20

Start Volume Reading (l)	0	Start Time	15:58:00
End Volume Reading (l)	40	End Time	16:30:00
Volume Sampled (l)	40.0	Total Time (min)	00:32:00
Corrected Volume Sampled (l)	37.4		
Sampling Rate (l/min)	1.2		

	IMPINGER			
	1	2	3	4
Start Weight of Impingers (g)	84.1	89.1	0	0
End Weight of Impingers (g)	83.6	88.9	0	0
Weight Gain (g)	-0.5	-0.2	0	0

Total Weight Gain (1+2+3+4) (g)	-0.7
Total Weight Gain in litres (l)	-0.87

Moisture Content of Gases (g/Nm³)	-18.7
Moisture Content of Gases (%)	0.00

2.2.4 Manual monitoring method - results – calculations

N/A.

2.2.5 Analysis results

N/A.

2.2.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 2 (05/12/13)

Data entered by: DS

Horiba Analyser: 1

Signal Analyser: 3

Type of Gas	CO		NO		VOCs	
Certified Calibration Values	149.3	ppm +/-2%	49.3	ppm +/-2%	9.83	ppm +/-2%
Response Time T90	8.0	seconds	10.0	seconds	2.00	seconds
Period						
Span PreCal direct to analyser	149.6	ppm	49.7	ppm	9.7	ppm
Zero PreCal through sample line	0.3	ppm	0.1	ppm	0.0	ppm
Span PreCal through sample line	148.6	ppm	49.4	ppm	9.9	ppm
Zero PostCal through sample line	-0.2	ppm	0.1	ppm	-0.1	ppm
Span PostCal through sample line	146.2	ppm	49.6	ppm	9.7	ppm
Span Drift	1.6	%	-0.4	%	2.3	%
Zero Drift	0.3	%	-0.1	%	0.6	%
Is data valid without adjustment	YES		YES		NO	
Does data require adjustment	NO		NO		YES	
Is data invalid	NO		NO		NO	

2.2.7 Instrumental gas analyser results

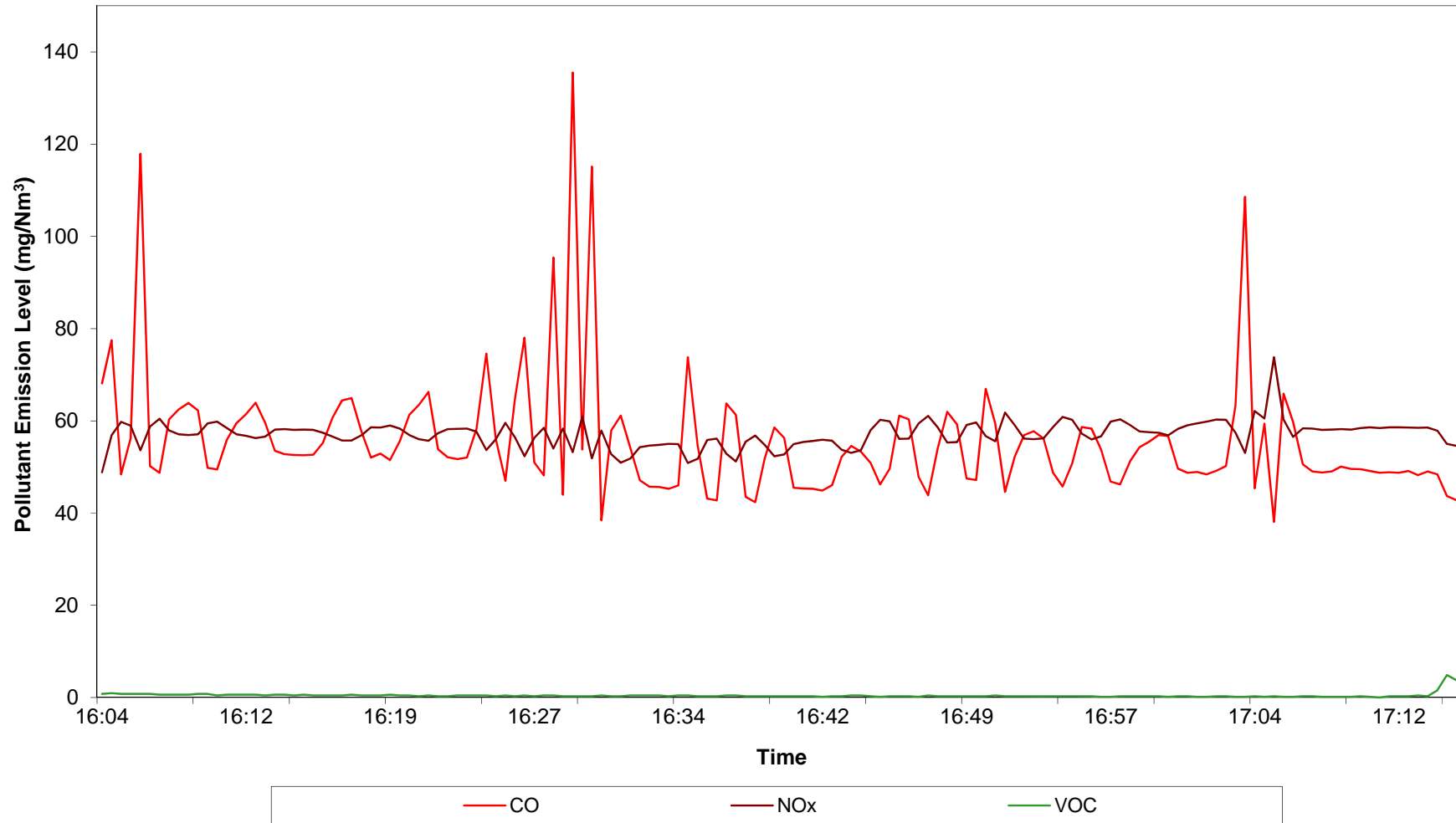
Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers

Wyndeham Heron, Maldon

Combustion Gas and VOC Emissions from Rotoman 2 (Lower) (05/12/13)

	Carbon Monoxide	Oxides of Nitrogen	VOCs	Adjusted for span/zero drift	Conversion from ppm to mg/Nm ³ WET		
	CO (ppm)	NOx (ppm)		VOCs (ppm)	CO (mg/Nm ³)	NOx (as NO ₂) (mg/Nm ³)	VOCs (mg/Nm ³)
Average	44.5	24.6	0.4	0.4	49.0	50.5	0.6
Maximum	108.4	35.9	3.1	3.0	135.5	73.8	4.9
Minimum	0.4	17.5	0.5	0.5	18.3	35.9	0.8

Combustion Gas and VOC Emissions from Rotoman 2 (Lower) Wyndeham Heron, Maldon (05/12/13)



2.2.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	44.5	ppm
Span Gas Certified Value =	149.3	ppm +/-2%
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.4450	0.1980
Zero Drift/Lower limit of detection (ppm)	0.42	Rectangular	1.732	0.2425	0.0588
Span Drift (ppm)	2.40	Rectangular	1.732	1.3857	1.9201
Linearity (% of value)	1.01	Rectangular	1.732	0.2595	0.0673
Setting Gas Divider (% of value)	0.25	Normal	1	0.1113	0.0124
Interference (% of value)	2.9	Rectangular	1.732	0.7451	0.5552
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.8620	0.7431
				Sum U ²	3.55
				Combined Standard Uncertainty (ppm)	1.89
				Expanded Total Uncertainty (ppm) (95% Confidence)	3.70
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	8.3
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	4.62
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.6

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	24.6	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.2460	0.0605
Zero Drift/Lower limit of detection (ppm)	-0.05	Rectangular	1.732	-0.0289	0.0008
Span Drift (ppm)	-0.20	Rectangular	1.732	-0.1155	0.0133
Linearity (% of value)	1.41	Rectangular	1.732	0.2003	0.0401
Setting Gas Divider (% of value)	0.25	Normal	1	0.0615	0.0038
Interference (% of value)	1.2	Rectangular	1.732	0.1704	0.0290
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.2846	0.0810
				Sum U ²	0.23
				Combined Standard Uncertainty (ppm)	0.48
				Expanded Total Uncertainty (ppm) (95% Confidence)	0.94
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	3.8
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	1.92
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	1.9

UNCERTAINTY OF VOC BY SIGNAL 3 Rotoman 2 (Lower)

Reading =	0.4	ppm as C ₃ H ₈
Span Gas=	9.83	ppm+/-2%
Emission Limit Value	20	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.0040	0.0000
Zero Drift/ Detection threshold	0.00	Rectangular	1.732	0.0000	0.0000
Span Drift (ppm)	0.00	Rectangular	1.732	0.0000	0.0000
Noise (ppm)	0.1	Rectangular	1.732	0.0577	0.0033
Linearity (% of value)	0.85	Rectangular	1.732	0.0020	0.0000
Setting Gas Divider (% of value)	0.25	Normal	1	0.0010	0.0000
Temperature Drift (% of value)	1	Rectangular	1.732	0.0023	0.0000
Span Gas (% of value)	1	Rectangular	1.732	0.0568	0.0032
				Sum U ²	0.01
				Combined Standard Uncertainty (ppm as C₃H₈)	0.08
				Expanded Total Uncertainty (ppm as C₃H₈) (95% Confidence)	0.16
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	39.8
				Expanded Total Uncertainty (mg/Nm³ as carbon) (95% Confidence)	0.26
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	1.3

2.3 Appendix 3: Rotoman 2 (Upper) Results and Calculations

2.3.1 Photograph of the sampling location and positions



2.3.2 Flow criteria measurements

DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 2 Upper** Date: **05/12/2013**
 Duct dimensions: **50.0 cm**
 Local barometric pressure: **1016 mbar**
 Ambient Temperature: **30 °C** Pitot Coefficient = **0.822**
 Micromanometer Calibration (K; mbar) = **289 1000**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.5	12.4	14.9	357
	A2	0.15	7.5	12.8	15.4	357
	A3	0.25	12.5	12.3	14.8	357
	A4	0.35	17.5	12.0	14.4	357
	A5	0.45	22.5	11.4	13.7	357
	A6	0.55	27.5	11.6	14.0	357
	A7	0.65	32.5	11.0	13.2	357
	A8	0.75	37.5	10.3	12.4	357
	A9	0.85	42.5	10.1	12.2	357
	A10	0.95	47.5	9.4	11.3	357

<u>Velocity readings (m/s)</u>			
Duct Mean m/s		13.6	
Highest(a)	15.4	Lowest (b)	11.3

<u>Temperature readings</u>			
Duct Mean °C		357	
Duct Mean K 630			
Highest(a)	357.0	Lowest (b)	357.0

<u>Volumetric flow rate</u>			
Duct dimensions	50.0	(cm)	
Duct area	0.196	(m ²)	
Mean duct velocity	13.6	(m/s)	
Mean duct temperature	357	(°C)	
Ambient pressure	1016	(mbar)	
Vol. Flow rate at stack conditions	9643	(m³/hr)	
Vol flow rate corrd.	4191.0	(Nm³/hr)	

2.3.3 Water vapour measurements

MOISTURE TEST FORM

Client Name: Wyndeham Heron
Job Number: 5875

Date: 05/12/2013

Stack Reference:

Ambient Pressure (mbar): 1017
Stack Temperature (°C): 357
Gasmeter Coefficient: 1.000
Equipment used:
Leak Check (l/min) Before: 0
After: 0

Gas Meter Temperature (°C):

Start: 18
End: 22
Mean: 20

Start Volume Reading (l)	0	Start Time	14:44:00
End Volume Reading (l)	38	End Time	15:22:00
Volume Sampled (l)	38.0	Total Time (min)	00:38:00
Corrected Volume Sampled (l)	35.5		
Sampling Rate (l/min)	0.9		

	IMPINGER			
	1	2	3	4
Start Weight of Impingers (g)	84.1	89.1	0	0
End Weight of Impingers (g)	83.8	89	0	0
Weight Gain (g)	-0.3	-0.1	0	0

Total Weight Gain (1+2+3+4) (g)	-0.4
Total Weight Gain in litres (l)	-0.50

Moisture Content of Gases (g/Nm³)	-11.3
Moisture Content of Gases (%)	0.00

2.3.4 Manual monitoring method - results – calculations

N/A.

2.3.5 Analysis results

N/A.

2.3.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 2 (05/12/13)

Data entered by: DS

Horiba Analyser: 1

Signal Analyser: 3

Type of Gas	CO		NO		VOCs	
Certified Calibration Values	149.3	ppm +/-2%	49.3	ppm +/-2%	9.83	ppm +/-2%
Response Time T90	8.0	seconds	10.0	seconds	2.00	seconds
Period						
Span PreCal direct to analyser	149.6	ppm	49.7	ppm	9.7	ppm
Zero PreCal through sample line	0.3	ppm	0.1	ppm	0.0	ppm
Span PreCal through sample line	148.6	ppm	49.4	ppm	9.9	ppm
Zero PostCal through sample line	-0.2	ppm	0.1	ppm	-0.1	ppm
Span PostCal through sample line	146.2	ppm	49.6	ppm	9.7	ppm
Span Drift	1.6	%	-0.4	%	2.3	%
Zero Drift	0.3	%	-0.1	%	0.6	%
Is data valid without adjustment	YES		YES		NO	
Does data require adjustment	NO		NO		YES	
Is data invalid	NO		NO		NO	

2.3.7 Instrumental gas analyser results

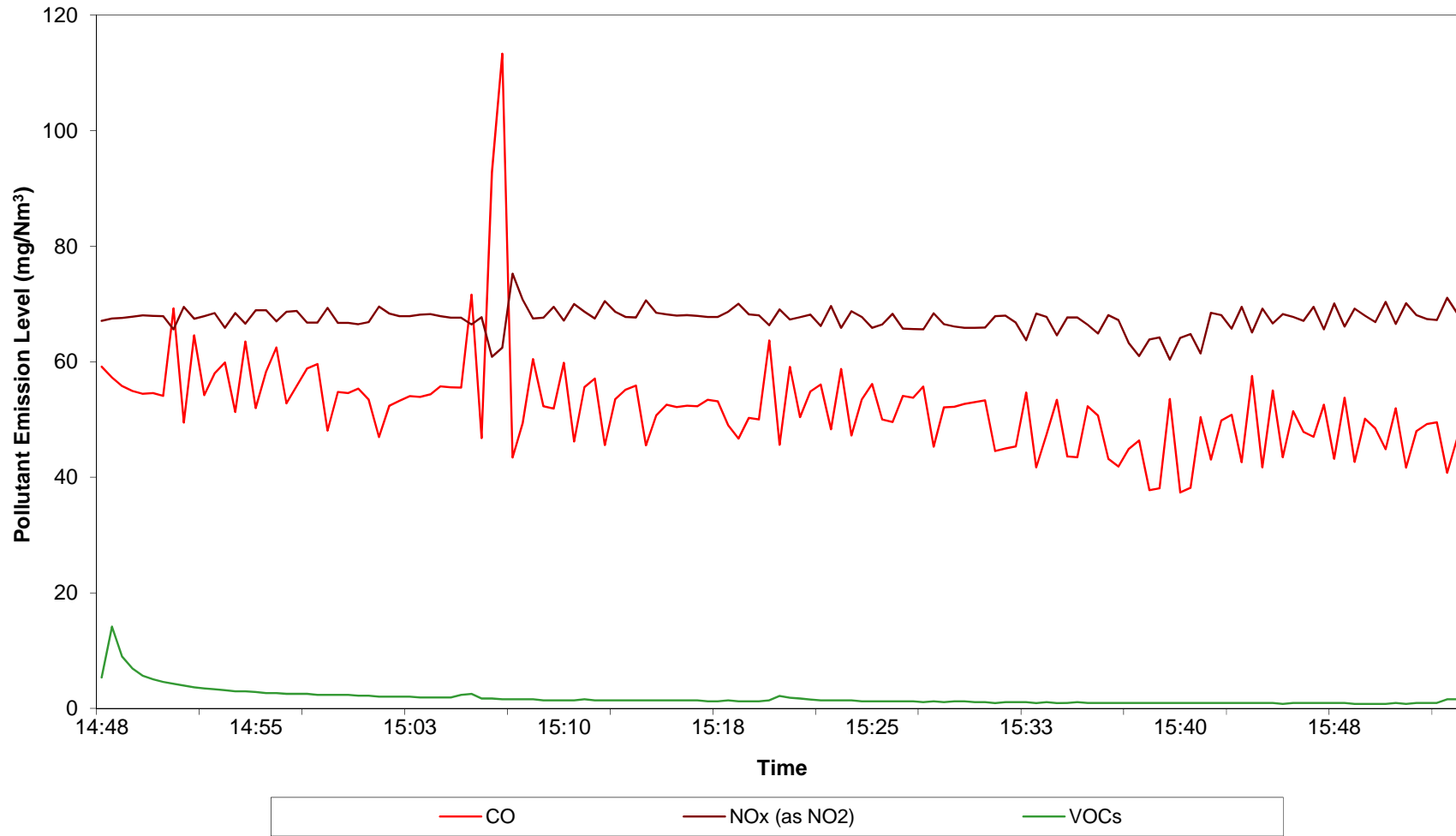
Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers

Wyndeham Heron, Maldon

Combustion Gas and VOC Emissions from Rotoman 2 (Upper) (05/12/13)

	Carbon Monoxide	Oxides of Nitrogen	VOCs	Adjusted for span/zero drift	Conversion from ppm to mg/Nm ³ WET		
	CO (ppm)	NOx (ppm)		VOCs (ppm)	CO (mg/Nm ³)	NOx (as NO ₂) (mg/Nm ³)	VOCs (mg/Nm ³)
Average	41.7	32.8	1.2	1.1	52.2	67.4	1.8
Maximum	90.6	36.7	9.0	8.8	113.3	75.2	14.2
Minimum	29.9	29.4	0.5	0.5	37.4	60.4	0.8

Combustion Gas and VOC Emissions from Rotoman 2 (Upper) Wyndeham Heron, Maldon (05/12/13)



2.3.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 1

Reading =	41.7	ppm
Span Gas Certified Value =	149.3	ppm +/-2%
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.4170	0.1739
Zero Drift/Lower limit of detection (ppm)	0.42	Rectangular	1.732	0.2425	0.0588
Span Drift (ppm)	2.40	Rectangular	1.732	1.3857	1.9201
Linearity (% of value)	1.01	Rectangular	1.732	0.2432	0.0591
Setting Gas Divider (% of value)	0.25	Normal	1	0.1043	0.0109
Interference (% of value)	2.9	Rectangular	1.732	0.6982	0.4875
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.8620	0.7431
				Sum U ²	3.45
				Combined Standard Uncertainty (ppm)	1.86
				Expanded Total Uncertainty (ppm) (95% Confidence)	3.64
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	8.7
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	4.55
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.6

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 1

Reading =	32.8	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.3280	0.1076
Zero Drift/Lower limit of detection (ppm)	-0.05	Rectangular	1.732	-0.0289	0.0008
Span Drift (ppm)	-0.20	Rectangular	1.732	-0.1155	0.0133
Linearity (% of value)	1.41	Rectangular	1.732	0.2670	0.0713
Setting Gas Divider (% of value)	0.25	Normal	1	0.0820	0.0067
Interference (% of value)	1.2	Rectangular	1.732	0.2273	0.0516
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.2846	0.0810
				Sum U ²	0.33
				Combined Standard Uncertainty (ppm)	0.58
				Expanded Total Uncertainty (ppm) (95% Confidence)	1.13
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	3.4
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	2.32
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	2.3

UNCERTAINTY OF VOC BY SIGNAL 3 (Rotoman 2 Upper)

Reading =	1.2	ppm as C ₃ H ₈
Span Gas =	9.83	ppm +/-2%
Emission Limit Value	20	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.0120	0.0001
Zero Drift/ Detection threshold	0.06	Rectangular	1.732	0.0346	0.0012
Span Drift (ppm)	0.23	Rectangular	1.732	0.1328	0.0176
Noise (ppm)	0.1	Rectangular	1.732	0.0577	0.0033
Linearity (% of value)	0.85	Rectangular	1.732	0.0059	0.0000
Setting Gas Divider (% of value)	0.25	Normal	1	0.0030	0.0000
Temperature Drift (% of value)	1	Rectangular	1.732	0.0069	0.0000
Span Gas (% of value)	1	Rectangular	1.732	0.0568	0.0032
				Sum U ²	0.03
				Combined Standard Uncertainty (ppm as C₃H₈)	0.16
				Expanded Total Uncertainty (ppm as C₃H₈) (95% Confidence)	0.31
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	26.1
				Expanded Total Uncertainty (mg/Nm³ as carbon) (95% Confidence)	0.50
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	2.5

2.4 Appendix 4: Rotoman 3 (Lower) Results and Calculations

2.3.1 Photograph of the sampling location and positions



2.4.2 Flow criteria measurements

DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 3 Lower** Date: **05/12/2013**
 Duct dimensions: **50.0 cm**
 Local barometric pressure: **1016 mbar**
 Ambient Temperature: **30 °C** Pitot Coefficient = **0.822**
 Micromanometer Calibration (K; mbar) = **289 1000**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.5	11.7	14.4	381
	A2	0.15	7.5	11.5	14.1	381
	A3	0.25	12.5	12.2	15.0	381
	A4	0.35	17.5	12.4	15.2	381
	A5	0.45	22.5	12.6	15.5	381
	A6	0.55	27.5	12.2	15.0	381
	A7	0.65	32.5	11.9	14.6	381
	A8	0.75	37.5	11.8	14.5	381
	A9	0.85	42.5	10.9	13.4	381
	A10	0.95	47.5	10.1	12.4	381

<u>Velocity readings (m/s)</u>			
Duct Mean m/s		14.4	
Highest(a)	15.5	Lowest (b)	12.4

<u>Temperature readings</u>			
Duct Mean °C		381	
Duct Mean K 654			
Highest(a)	381.0	Lowest (b)	381.0

<u>Volumetric flow rate</u>			
Duct dimensions	50.0	(cm)	
Duct area	0.196	(m ²)	
Mean duct velocity	14.4	(m/s)	
Mean duct temperature	381	(°C)	
Ambient pressure	1016	(mbar)	
Vol. Flow rate at stack conditions	10172	(m³/hr)	
Vol flow rate corrd.	4258.6	(Nm³/hr)	

2.4.3 Water vapour measurements

MOISTURE TEST FORM

Client Name: Wyndeham Heron
Job Number: 5875

Date: 05/12/2013

Stack Reference:

Ambient Pressure (mbar): 1019
Stack Temperature (°C): 376
Gasmeter Coefficient: 1.000
Equipment used:
Leak Check (l/min) Before: 0
After: 0

Gas Meter Temperature (°C):
Start: 18
End: 22
Mean: 20

Start Volume Reading (l)	0	Start Time	11:26:00
End Volume Reading (l)	64	End Time	11:58:00
Volume Sampled (l)	64.0	Total Time (min)	00:32:00
Corrected Volume Sampled (l)	60.0		
Sampling Rate (l/min)	1.9		

	IMPINGER			
	1	2	3	4
Start Weight of Impingers (g)	20.0	17	0	0
End Weight of Impingers (g)	20.2	17.1	0	0
Weight Gain (g)	0.2	0.1	0	0

Total Weight Gain (1+2+3+4) (g)	0.3
Total Weight Gain in litres (l)	0.37

Moisture Content of Gases (g/Nm³)	5.0
Moisture Content of Gases (%)	0.62

2.4.4 Manual monitoring method - results – calculations

N/A.

2.4.5 Analysis results

N/A.

2.4.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 3 (05/12/13)

Data entered by: DS

Horiba Analyser: 2

Signal Analyser: Hire

Type of Gas	CO		NO		VOCs	
Certified Calibration Values	149.3	ppm +/-2%	49.3	ppm +/-2%	9.74	ppm +/-2%
Response Time T90	12.0	seconds	10.0	seconds	5.00	seconds
Period						
Span PreCal direct to analyser	149.7	ppm	49.5	ppm	9.9	ppm
Zero PreCal through sample line	0.9	ppm	0.1	ppm	0.4	ppm
Span PreCal through sample line	151.1	ppm	48.4	ppm	10.1	ppm
Zero PostCal through sample line	0.3	ppm	0.2	ppm	0.0	ppm
Span PostCal through sample line	148.3	ppm	48.5	ppm	9.9	ppm
Span Drift	1.9	%	-0.2	%	2.1	%
Zero Drift	0.4	%	-0.1	%	4.1	%
Is data valid without adjustment	YES		YES		NO	
Does data require adjustment	NO		NO		YES	
Is data invalid	NO		NO		NO	

2.4.7 Instrumental gas analyser results

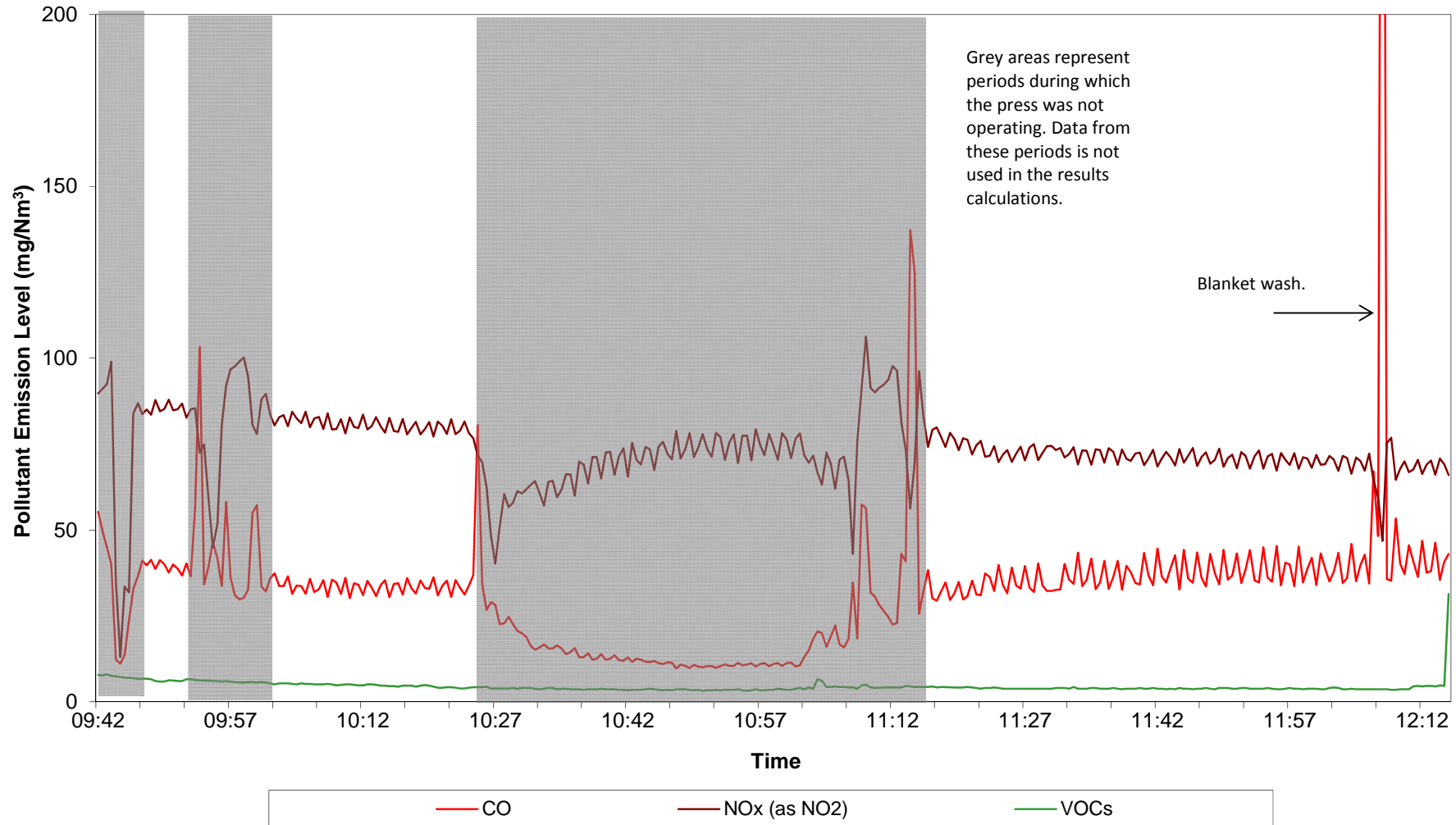
Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers

Wyndeham Heron, Maldon

Combustion Gas and VOC Emissions from Rotoman 3 (Lower) (05/12/13)

	Carbon Monoxide	Oxides of Nitrogen	VOCs	Adjusted for span/zero drift	Conversion from ppm to mg/Nm ³ WET		
	CO (ppm)	NOx (ppm)		VOCs (ppm)	CO (mg/Nm ³)	NOx (as NO ₂) (mg/Nm ³)	VOCs (mg/Nm ³)
Average	31.4	36.7	2.4	2.8	39.0	74.9	4.5
Maximum	364.8	47.1	19.1	19.5	453.2	96.1	31.3
Minimum	20.6	23.0	1.8	2.2	25.6	46.9	3.5

Combustion Gas and VOC Emissions from Rotoman 3 (Lower) Wyndeham Heron, Maldon (05/12/13)



2.4.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 2

Reading =	31.4	ppm
Span Gas Certified Value =	149.3	ppm +/-2%
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.3140	0.0986
Zero Drift/Lower limit of detection (ppm)	0.56	Rectangular	1.732	0.3233	0.1045
Span Drift (ppm)	2.80	Rectangular	1.732	1.6166	2.6135
Linearity (% of value)	0.54	Rectangular	1.732	0.0979	0.0096
Setting Gas Divider (% of value)	0.25	Normal	1	0.0785	0.0062
Interference (% of value)	2.9	Rectangular	1.732	0.5258	0.2764
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.8620	0.7431
				Sum U ²	3.85
				Combined Standard Uncertainty (ppm)	1.96
				Expanded Total Uncertainty (ppm) (95% Confidence)	3.85
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	12.3
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	4.81
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.8

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 2

Reading =	36.7	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.3670	0.1347
Zero Drift/Lower limit of detection (ppm)	-0.04	Rectangular	1.732	-0.0254	0.0006
Span Drift (ppm)	-0.10	Rectangular	1.732	-0.0577	0.0033
Linearity (% of value)	1.16	Rectangular	1.732	0.2458	0.0604
Setting Gas Divider (% of value)	0.25	Normal	1	0.0918	0.0084
Interference (% of value)	1.2	Rectangular	1.732	0.2543	0.0647
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.2846	0.0810
				Sum U ²	0.35
				Combined Standard Uncertainty (ppm)	0.59
				Expanded Total Uncertainty (ppm) (95% Confidence)	1.16
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	3.2
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	2.39
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	2.4

UNCERTAINTY OF VOC BY SIGNAL (Rotoman 3 Lower)

Reading =	2.4	ppm as C3H8
Span Gas =	9.74	ppm +/-2%
Emission Limit Value	20	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.0240	0.0006
Zero Drift/ Detection threshold	0.40	Rectangular	1.732	0.2309	0.0533
Span Drift (ppm)	0.20	Rectangular	1.732	0.1155	0.0133
Noise (ppm)	0.1	Rectangular	1.732	0.0577	0.0033
Linearity (% of value)	1.65	Rectangular	1.732	0.0229	0.0005
Setting Gas Divider (% of value)	0.25	Normal	1	0.0060	0.0000
Temperature Drift (% of value)	1	Rectangular	1.732	0.0139	0.0002
Span Gas (% of value)	1	Rectangular	1.732	0.0562	0.0032
				Sum U ²	0.07
				Combined Standard Uncertainty (ppm as C3H8)	0.27
				Expanded Total Uncertainty (ppm as C3H8) (95% Confidence)	0.53
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	22.3
				Expanded Total Uncertainty (mg/Nm³ as carbon) (95% Confidence)	0.86
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.3

2.5 Appendix 5: Rotoman 3 (Upper) Results and Calculations

2.5.1 Photograph of the sampling location and positions



2.5.2 Flow criteria measurements

DUCT TEMPERATURE AND VELOCITY TRAVERSE DATA Wyndeham Heron, Maldon

Stack reference: **Rotoman 3 Upper** Date: **05/12/2013**
 Duct dimensions: **50.0 cm**
 Local barometric pressure: **1016 mbar**
 Ambient Temperature: **30 °C** Pitot Coefficient = **0.822**
 Micromanometer Calibration (K; mbar) = **289 1000**

Sample port (A)	Traverse point	Traverse position (D)	Distance (cm)	Velocity (m/s)		Temp (°C)
				Uncorr.	Corrd.	
Single	A1	0.05	2.5	7.2	8.8	376
	A2	0.15	7.5	8.0	9.8	376
	A3	0.25	12.5	8.1	9.9	376
	A4	0.35	17.5	9.1	11.1	376
	A5	0.45	22.5	9.3	11.4	376
	A6	0.55	27.5	9.1	11.1	376
	A7	0.65	32.5	10.0	12.2	376
	A8	0.75	37.5	9.7	11.9	376
	A9	0.85	42.5	9.7	11.9	376
	A10	0.95	47.5	9.1	11.1	376

<u>Velocity readings (m/s)</u>			
Duct Mean m/s		10.9	
Highest(a)	12.2	Lowest (b)	8.8

<u>Temperature readings</u>			
Duct Mean °C		376	
Duct Mean K 649			
Highest(a)	376.0	Lowest (b)	376.0

<u>Volumetric flow rate</u>			
Duct dimensions	50.0	(cm)	
Duct area	0.196	(m ²)	
Mean duct velocity	10.9	(m/s)	
Mean duct temperature	376	(°C)	
Ambient pressure	1016	(mbar)	
Vol. Flow rate at stack conditions	7714	(m³/hr)	
Vol flow rate corrd.	3254.5	(Nm³/hr)	

2.5.3 Water vapour measurements

MOISTURE TEST FORM

Client Name: Wyndeham Heron
Job Number: 5875

Date: 05/12/2013

Stack Reference:

Ambient Pressure (mbar): 1019
Stack Temperature (°C): 376
Gasmeter Coefficient: 1.000
Equipment used:
Leak Check (l/min) Before: 0
After: 0

Gas Meter Temperature (°C):
Start: 18
End: 22
Mean: 20

Start Volume Reading (l)	0	Start Time	12:28:00
End Volume Reading (l)	86	End Time	13:11:00
Volume Sampled (l)	86.0	Total Time (min)	00:43:00
Corrected Volume Sampled (l)	80.6		
Sampling Rate (l/min)	1.9		

	IMPINGER			
	1	2	3	4
Start Weight of Impingers (g)	20.2	17.1	0	0
End Weight of Impingers (g)	22.1	16.4	0	0
Weight Gain (g)	1.9	-0.7	0	0

Total Weight Gain (1+2+3+4) (g)	1.2
Total Weight Gain in litres (l)	1.49

Moisture Content of Gases (g/Nm³)	14.9
Moisture Content of Gases (%)	1.82

2.5.4 Manual monitoring method - results – calculations

N/A.

2.5.5 Analysis results

N/A.

2.5.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Rotoman 3 (05/12/13)

Data entered by: DS

Horiba Analyser: 2

Signal Analyser: Hire

Type of Gas	CO		NO		VOCs	
Certified Calibration Values	149.3	ppm +/-2%	49.3	ppm +/-2%	9.74	ppm +/-2%
Response Time T90	12.0	seconds	10.0	seconds	5.00	seconds
Period						
Span PreCal direct to analyser	149.7	ppm	49.5	ppm	9.9	ppm
Zero PreCal through sample line	0.9	ppm	0.1	ppm	0.4	ppm
Span PreCal through sample line	151.1	ppm	48.4	ppm	10.1	ppm
Zero PostCal through sample line	0.3	ppm	0.2	ppm	0.0	ppm
Span PostCal through sample line	148.3	ppm	48.5	ppm	9.9	ppm
Span Drift	1.9	%	-0.2	%	2.1	%
Zero Drift	0.4	%	-0.1	%	4.1	%
Is data valid without adjustment	YES		YES		NO	
Does data require adjustment	NO		NO		YES	
Is data invalid	NO		NO		NO	

2.5.7 Instrumental gas analyser results

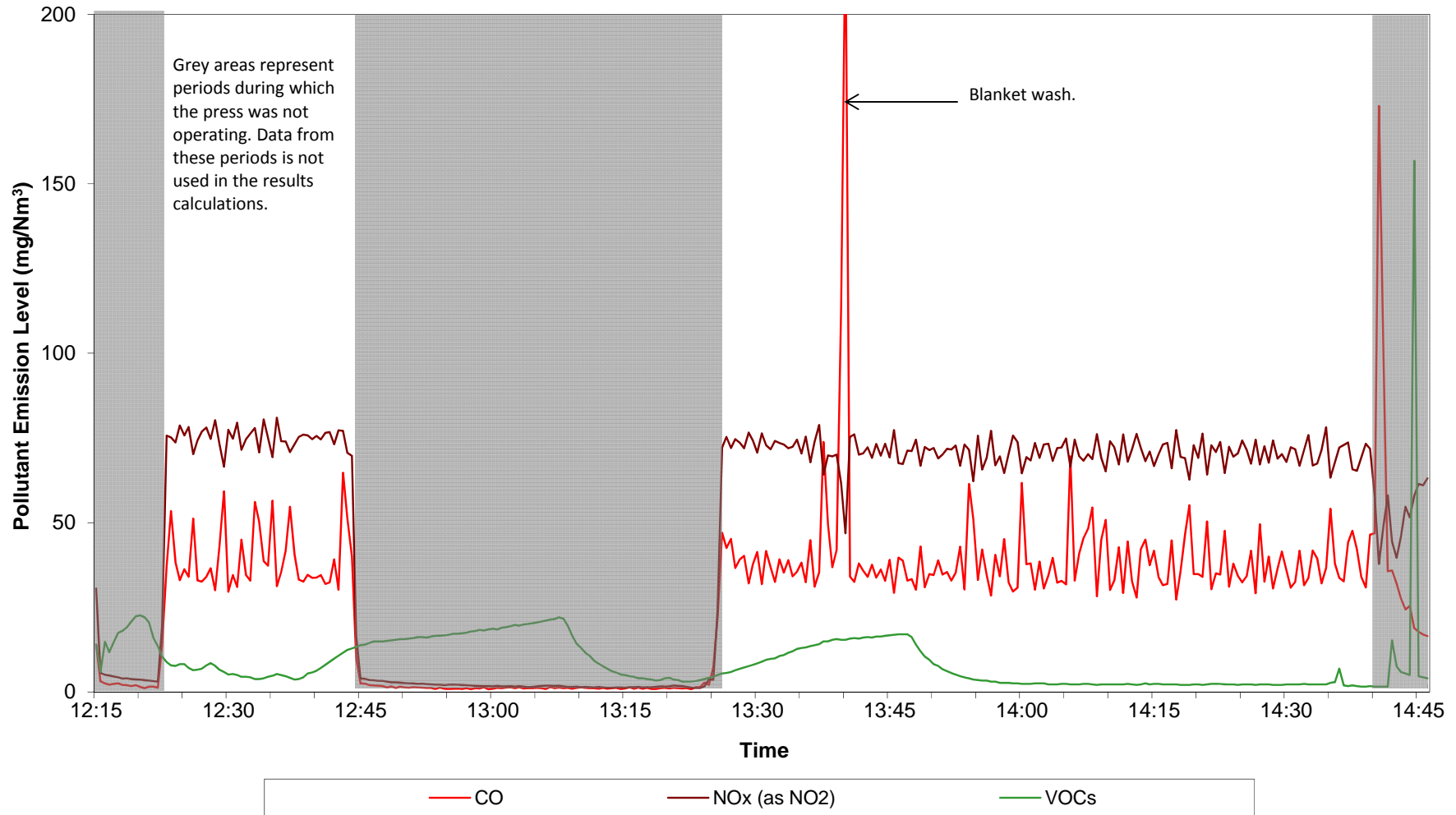
Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers

Wyndeham Heron, Maldon

Combustion Gas and VOC Emissions from Rotoman 3 (Upper) (05/12/13)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	VOCs (ppm)	Adjusted for span/zero drift VOCs (ppm)	Conversion from ppm to mg/Nm ³ WET		
					CO (mg/Nm ³)	NOx (as NO ₂) (mg/Nm ³)	VOCs (mg/Nm ³)
Average	32.2	35.3	3.4	3.8	39.5	71.1	6.1
Maximum	185.5	40.2	10.2	10.6	227.6	81.0	17.0
Minimum	11.4	9.6	0.6	1.0	14.1	19.4	1.6

Combustion Gas and VOC Emissions from Rotoman 3 (Upper) Wyndeham Heron, Maldon (05/12/13)



2.5.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 2

Reading =	32.2	ppm
Span Gas Certified Value =	149.3	ppm +/-2%
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.3220	0.1037
Zero Drift/Lower limit of detection (ppm)	0.56	Rectangular	1.732	0.3233	0.1045
Span Drift (ppm)	2.80	Rectangular	1.732	1.6166	2.6135
Linearity (% of value)	0.54	Rectangular	1.732	0.1004	0.0101
Setting Gas Divider (% of value)	0.25	Normal	1	0.0805	0.0065
Interference (% of value)	2.9	Rectangular	1.732	0.5391	0.2907
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.8620	0.7431
				Sum U ²	3.87
				Combined Standard Uncertainty (ppm)	1.97
				Expanded Total Uncertainty (ppm) (95% Confidence)	3.86
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	12.0
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	4.82
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.8

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 2

Reading =	35.3	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.3530	0.1246
Zero Drift/Lower limit of detection (ppm)	-0.04	Rectangular	1.732	-0.0254	0.0006
Span Drift (ppm)	-0.10	Rectangular	1.732	-0.0577	0.0033
Linearity (% of value)	1.16	Rectangular	1.732	0.2364	0.0559
Setting Gas Divider (% of value)	0.25	Normal	1	0.0883	0.0078
Interference (% of value)	1.2	Rectangular	1.732	0.2446	0.0598
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.2846	0.0810
				Sum U ²	0.33
				Combined Standard Uncertainty (ppm)	0.58
				Expanded Total Uncertainty (ppm) (95% Confidence)	1.13
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	3.2
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	2.32
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	2.3

UNCERTAINTY OF VOC BY SIGNAL (Rotoman 3 Upper)

Reading =	3.4	ppm as C3H8
Span Gas =	9.74	ppm +/-2%
Emission Limit Value	20	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.0340	0.0012
Zero Drift/ Detection threshold	0.40	Rectangular	1.732	0.2309	0.0533
Span Drift (ppm)	0.20	Rectangular	1.732	0.1155	0.0133
Noise (ppm)	0.1	Rectangular	1.732	0.0577	0.0033
Linearity (% of value)	1.65	Rectangular	1.732	0.0324	0.0010
Setting Gas Divider (% of value)	0.25	Normal	1	0.0085	0.0001
Temperature Drift (% of value)	1	Rectangular	1.732	0.0196	0.0004
Span Gas (% of value)	1	Rectangular	1.732	0.0562	0.0032
				Sum U ²	0.08
				Combined Standard Uncertainty (ppm as C3H8)	0.28
				Expanded Total Uncertainty (ppm as C3H8) (95% Confidence)	0.54
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	15.9
				Expanded Total Uncertainty (mg/Nm³ as carbon) (95% Confidence)	0.87
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	4.3

2.6 Appendix 6: Lithoman 1 Results and Calculations

2.6.1 Photograph of the sampling location and positions



2.6.2 Flow criteria measurements

Not available due to equipment malfunction

2.6.3 Water vapour measurements

MOISTURE TEST FORM

Client Name: Wyndeham Heron
Job Number: 5875

Date: 05/12/2013

Stack Reference:

Ambient Pressure (mbar): 1017
Stack Temperature (°C): 361
Gasmeter Coefficient: 1.000
Equipment used:
Leak Check (l/min) Before: 0
After: 0

Gas Meter Temperature (°C):

Start: 18
End: 22
Mean: 20

Start Volume Reading (l)	0	Start Time	10:41:00
End Volume Reading (l)	100	End Time	11:31:00
Volume Sampled (l)	100.0	Total Time (min)	00:50:00
Corrected Volume Sampled (l)	93.5		
Sampling Rate (l/min)	1.9		

	IMPINGER			
	1	2	3	4
Start Weight of Impingers (g)	91.8	86.6	0	0
End Weight of Impingers (g)	90.1	89.4	0	0
Weight Gain (g)	-1.7	2.8	0	0

Total Weight Gain (1+2+3+4) (g)	1.1
Total Weight Gain in litres (l)	1.37

Moisture Content of Gases (g/Nm³)	11.8
Moisture Content of Gases (%)	1.44

2.6.4 Manual monitoring method - results – calculations

N/A.

2.6.5 Analysis results

N/A.

2.6.6 Instrumental gas analyser site calibration measurements

ANALYSER CALIBRATIONS

Combustion Gas and VOC Emissions from Lithoman 1 (06/12/13)

Data entered by: DS

Horiba Analyser: 2

Signal Analyser: Hire

Type of Gas	CO		NO		VOCs	
Certified Calibration Values	149.3	ppm +/-2%	49.3	ppm +/-2%	9.74	ppm +/-2%
Response Time T90	10.0	seconds	8.0	seconds	3.00	seconds
Period						
Span PreCal direct to analyser	149.6	ppm	49.5	ppm	9.7	ppm
Zero PreCal through sample line	-0.3	ppm	-0.3	ppm	0.1	ppm
Span PreCal through sample line	148.4	ppm	48.6	ppm	9.9	ppm
Zero PostCal through sample line	-1.0	ppm	-0.3	ppm	0.1	ppm
Span PostCal through sample line	148.8	ppm	48.8	ppm	9.8	ppm
Span Drift	-0.3	%	-0.5	%	1.3	%
Zero Drift	0.4	%	0.0	%	-0.9	%
Is data valid without adjustment	YES		YES		YES	
Does data require adjustment	NO		NO		NO	
Is data invalid	NO		NO		NO	

2.6.7 Instrumental gas analyser results

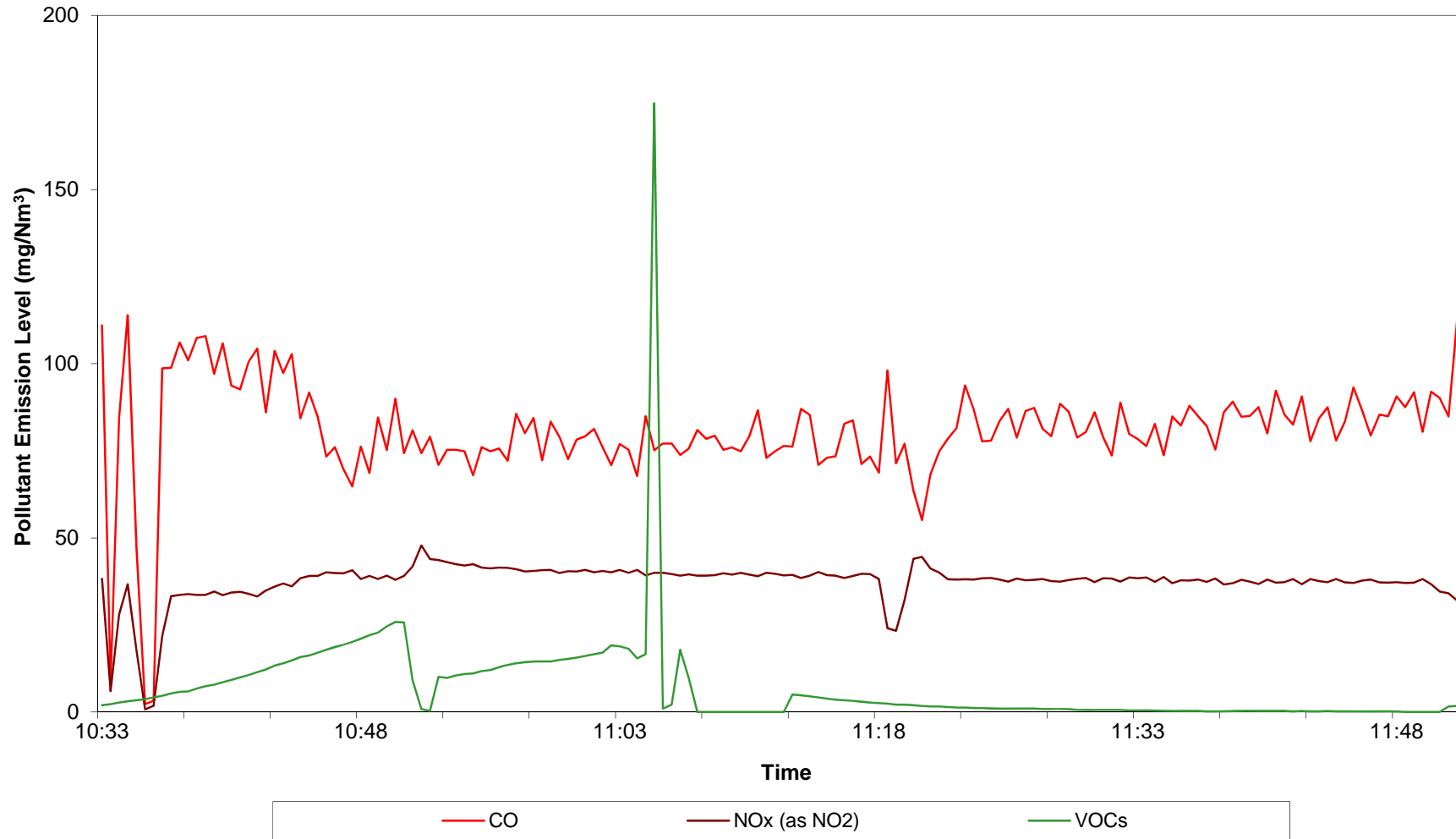
Gaseous Analysis using Horiba PG 250 & Signal 3030PM Analysers

Wyndeham Heron, Maldon

Combustion Gas and VOC Emissions from Lithoman 1 (06/12/13)

	Carbon Monoxide CO (ppm)	Oxides of Nitrogen NOx (ppm)	VOCs (ppm)	Conversion from ppm to mg/Nm ³ WET		
				CO (mg/Nm ³)	NOx (as NO ₂) (mg/Nm ³)	VOCs (mg/Nm ³)
Average	64.4	25.9	7.0	79.3	37.0	11.2
Maximum	92.4	33.5	108.7	113.9	47.8	174.7
Minimum	1.8	0.5	0.0	2.2	0.8	0.0

Combustion Gas and VOC Emissions from Lithoman 1 Wyndeham Heron, Maldon (06/12/13)



2.6.8 Uncertainty calculations

UNCERTAINTY OF CARBON MONOXIDE BY HORIBA 2

Reading =	64.4	ppm
Span Gas Certified Value =	149.3	ppm +/-2%
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.6440	0.4147
Zero Drift/Lower limit of detection (ppm)	0.64	Rectangular	1.732	0.3695	0.1365
Span Drift (ppm)	-0.40	Rectangular	1.732	-0.2309	0.0533
Linearity (% of value)	0.54	Rectangular	1.732	0.2008	0.0403
Setting Gas Divider (% of value)	0.25	Normal	1	0.1610	0.0259
Interference (% of value)	2.9	Rectangular	1.732	1.0783	1.1627
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.8620	0.7431
				Sum U ²	2.58
				Combined Standard Uncertainty (ppm)	1.61
				Expanded Total Uncertainty (ppm) (95% Confidence)	3.15
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	4.9
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	3.93
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	3.9

UNCERTAINTY OF OXIDES OF NITROGEN BY HORIBA 2

Reading =	25.9	ppm
Span Gas Certified Value =	49.3	ppm
Emission Limit Value	100	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.2590	0.0671
Zero Drift/Lower limit of detection (ppm)	-0.01	Rectangular	1.732	-0.0058	0.0000
Span Drift (ppm)	-0.25	Rectangular	1.732	-0.1443	0.0208
Linearity (% of value)	1.16	Rectangular	1.732	0.1735	0.0301
Setting Gas Divider (% of value)	0.25	Normal	1	0.0648	0.0042
Interference (% of value)	1.2	Rectangular	1.732	0.1794	0.0322
Span Gas (% of span gasvalue)	1	Rectangular	1.732	0.2846	0.0810
				Sum U ²	0.24
				Combined Standard Uncertainty (ppm)	0.49
				Expanded Total Uncertainty (ppm) (95% Confidence)	0.95
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	3.7
				Expanded Total Uncertainty (mg/Nm³) (95% Confidence)	1.95
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	2.0

UNCERTAINTY OF VOC BY SIGNAL

Reading =	7	ppm as C3H8
Span Gas =	9.74	ppm +/-2%
Emission Limit Value	20	mg/Nm ³

Parameter	Uncertainty criteria	Probability distribution	Divisor	U	U ²
Repeatability (% of value)	1	Normal	1	0.0700	0.0049
Zero Drift/ Detection threshold	-0.09	Rectangular	1.732	-0.0491	0.0024
Span Drift (ppm)	0.13	Rectangular	1.732	0.0722	0.0052
Noise (ppm)	0.1	Rectangular	1.732	0.0577	0.0033
Linearity (% of value)	1.65	Rectangular	1.732	0.0667	0.0044
Setting Gas Divider (% of value)	0.25	Normal	1	0.0175	0.0003
Temperature Drift (% of value)	1	Rectangular	1.732	0.0404	0.0016
Span Gas (% of value)	1	Rectangular	1.732	0.0562	0.0032
				Sum U ²	0.03
				Combined Standard Uncertainty (ppm as C3H8)	0.16
				Expanded Total Uncertainty (ppm as C3H8) (95% Confidence)	0.31
				Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)	4.5
				Expanded Total Uncertainty (mg/Nm³ as carbon) (95% Confidence)	0.50
				Expanded Total Uncertainty as a percentage of ELV (95% Confidence)	2.5

2.7 Appendix 7: Compactor Results and Calculations

2.7.1 Photograph of the sampling location and positions



2.7.2 Flow criteria measurements

N/A.

2.7.3 Water vapour measurements

N/A.

2.7.4 Analysis results

N/A.

2.7.5 Instrumental gas analyser site calibration measurements

N/A.

2.7.6 Instrumental gas analyser results

N/A.

2.7.7 Manual monitoring method - results – calculations

Wyndeham Heron
PARTICULATE MATTER EMISSIONS TO ATMOSPHERE DATA (MDHS 14 METHOD)

Site: Wyndeham Heron		Duct: Compactor															
Atmospheric Press: 1018 mbar																	
PARTICULATE MONITORING (MDHS-14)																	
Duct Reference	Pump No.	Filter No.	Flow Start (l/min)	Checks Finish (l/min)	Average Flow (l/min)	Time ON (hr:m:s)	Time OFF (hr:m:s)	Elapsed Time (hr:m:s)	Elapsed Time (min)	Air Volume Sampled (m ³)	Filter Masses			Concn. Partic. Matter (mg/m ³)	Corr. Part.Matt. Concn. (mg/Nm ³)	Air Temp. (°C)	
											Initial (mg)	Final (mg)	Difference (mg)				
1		30	113	2.70	2.00	2.35	11:23:00	15:00:00	03:37:00	217.00	0.51	27.31	28.40	1.09	2.14	2.0	27
2		HS1	A11	2.20	1.90	2.05	11:23:00	15:00:00	03:37:00	217.00	0.44	26.51	26.78	0.27	0.61	0.6	27
3		HS3	R8	2.20	1.90	2.05	11:23:00	15:00:00	03:37:00	217.00	0.44	26.90	27.69	0.79	1.78	1.6	27
4		HS2	67	1.80	1.80	1.80	11:23:00	15:00:00	03:37:00	217.00	0.39	26.95	27.38	0.43	1.10	1.0	27

2.7.8 Uncertainty calculations
N/A.