The Millbrook Power (Gas Fired Power Station) Order

6.2 Environmental Statement Appendices – Volume G Appendices 6.1 - 6.3 Air Quality

Planning Act 2008
The Infrastructure Planning
(Applications: Prescribed Forms and Procedure) Regulations 2009

PINS Reference Number:	EN010068
Document Reference:	6.2
Regulation Number:	5(2)(a) & Infrastructure Planning (Environmental Impact Assessment) Regulations 2009
Author:	Peter Brett Associates LLP

Revision	Date	Description
0	October 2017	Submission Version

Contents – Volume G – Air Quality

Air Quality

6.1- Air Quality Sensitivity Test

Operation

Stack height sensitivity testing was undertaken using the emissions data set out in Table 6.4 (section 6.5.32 of the ES Chapter) and meteorological data from Bedford meteorological station, from 2012 to 2016.

Dispersion model runs were undertaken for various stack heights between 27.5 and 45m with a model grid resolution of 44m. The optimum stack height was determined such that the maximum predicted annual NO_2 concentration was less than 1% of the long-term objective ($40\mu g/m^3$) and the maximum predicted hourly NO_2 concentration was less than 10% of the objective ($200\mu g/m^3$ as a 99.78th percentile).

Table 6.1.1 to 6.1.4 and Insert 6.1.1 show the results of the stack height sensitivity testing. Significant benefits are the stack height increases from 27.5m to 45m, as the effects of building downwash reduce. By 32.5 m, the maximum impact on ground level concentrations of NO_2 anywhere on the grid is less than 1% of the annual mean objective and 10% of the hourly mean objective. Beyond 35 m, whilst benefits are still seen with increasing stack height, the rate of reduction in impacts decreases significantly, especially for annual mean nitrogen dioxide concentrations.

Table 6.1.1 Stack Height Sensitivity Testing Results – Annual Mean

Stack Height (m)	Maximum Impacts in Study Area ($\mu g/m^3$)				
	2012	2013	2014	2015	2016
27.5	2.96	2.76	3.43	2.63	2.47
30.0	1.03	1.00	1.23	0.94	0.86
32.5	0.29	0.29	0.36	0.27	0.24
35.0	0.07	0.07	0.10	0.07	0.06
37.5	0.03	0.03	0.03	0.05	0.03
40.0	0.03	0.03	0.03	0.04	0.03
42.5	0.03	0.03	0.03	0.04	0.02
45.0	0.03	0.03	0.03	0.04	0.02
Objective	40				

Table 6.1.2 Stack Height Sensitivity Testing Results – Percentage Environmental Assessment Level
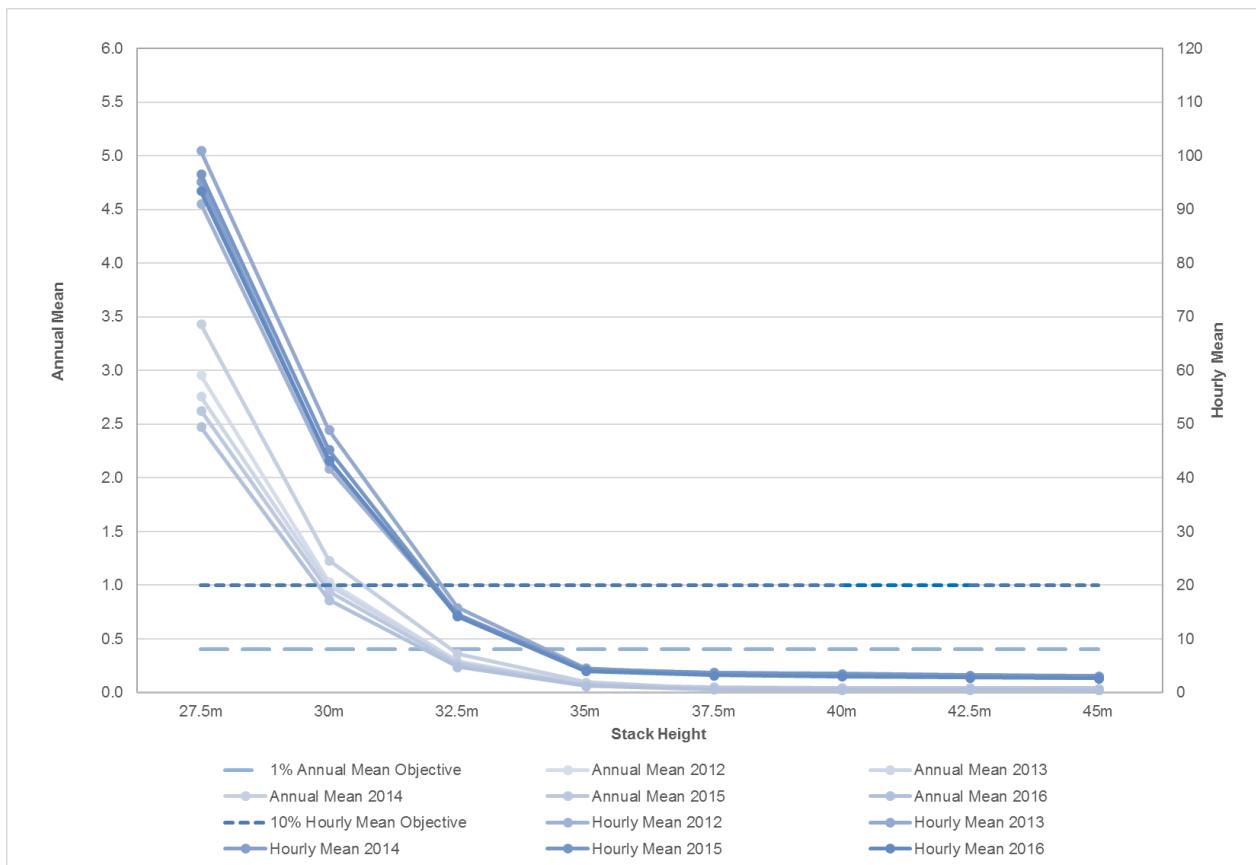
Stack Height (m)	% EAL				
	2012	2013	2014	2015	2016
27.5	**7.39**	**6.89**	**8.58**	**6.57**	**6.19**
30.0	**2.58**	**2.49**	**3.08**	**2.35**	**2.16**
32.5	0.72	0.72	0.90	0.67	0.60
35.0	0.18	0.19	0.24	0.17	0.15
37.5	0.08	0.09	0.08	0.12	0.07
40.0	0.07	0.08	0.08	0.11	0.07
42.5	0.07	0.07	0.07	0.10	0.06
45.0	0.06	0.07	0.07	0.10	0.06
Objective	1%				

Table 6.1.3 Stack Height Sensitivity Testing Results – Hourly Mean

Stack Height (m)	Maximum Impacts in Study Area ($\mu g/m^3$)				
	2012	2013	2014	2015	2016
27.5	91.09	100.97	95.16	96.68	93.46
30.0	41.79	48.93	43.02	45.22	43.35
32.5	14.41	15.84	14.41	14.51	14.16
35.0	4.27	4.53	4.36	4.24	3.97
37.5	3.38	3.31	3.69	3.72	3.17
40.0	3.13	3.10	3.41	3.45	2.97
42.5	2.90	2.90	3.19	3.22	2.79
45.0	2.69	2.71	3.01	3.04	2.62
Objective	200				

Table 6.1.4 Stack Height Sensitivity Testing Results – Percentage Environmental Assessment Level

Stack Height (m)	% EAL				
	2012	2013	2014	2015	2016
27.5	**45.55**	**50.48**	**47.58**	**48.34**	**46.73**
30.0	**20.90**	**24.46**	**21.51**	**22.61**	**21.67**
32.5	7.21	7.92	7.21	7.26	7.08
35.0	2.13	2.26	2.18	2.12	1.99
37.5	1.69	1.66	1.85	1.86	1.58
40.0	1.56	1.55	1.71	1.72	1.48
42.5	1.45	1.45	1.60	1.61	1.40
45.0	1.35	1.36	1.50	1.52	1.31
Objective	**10%**				

Insert 6.1.1 Stack Height Sensitivity Testing

The maximum impacts predicted with Bedford station meteorological data, when compared with Cranfield meteorological station, are slightly lower with stacks height from 32.5m to 45m. Therefore, for the recommended minimum stack height of 32.5 m the Cranfield station represents the worst-case scenario.

6.2- Cumulative Dispersion Modelling Inputs

Emissions Data

The emissions data for the Covanta plant are shown in Table 6.2.1.

Table 6.2.1: Emissions Data for the Covanta RRF

Parameter	Value Per Generator
Type	EFW
Number of stacks (3 flues)	1
Discharge Location	501247, 241049
Discharge Height (m)	105
Equivalent Total Flue Diameter (mm)	3,118
Discharge temperature (^{o}C)	137
Total Flow rate (m^3/s)	144.9
Total Flow rate (Nm^3/s, dry, reference O_2)	117.3
Exit velocity (m/s)	18.9
NO_x concentration (mg/Nm^3)	200
Total NO_x emission rate (g/s)	23.5
CO Concentration (mg/Nm^3)	25
Total CO emission rate (g/s)	2.9

Table 6.2.2: Covanta RRF Buildings Dimensions

Covanta			
	Height	Length	Width
G2 boiler house	38	34	33
G2 refuse hall	36	38	10

The Covanta buildings were included in the model of the cumulative impacts.

6.3 Cumulative Impacts

Table 6.3.1: Short-term Results of Stack Modelling for Human Health Sensitive Receptors, with Covanta

ID	Nitrogen Dioxide (NO$_2$)		Carbon Monoxide (CO)	
	Hourly mean PC (99.79th %ile µg/m^3)	Percentage of EAL (%)	Running 8 hour mean PC (µg/m^3)	Percentage of EAL (%)
R1	5.6	2.8	17.2	0.2
R2	5.5	2.8	20.9	0.2
R3	5.4	2.7	17.1	0.2
R4	5.5	2.7	20.7	0.2
R5	2.9	1.4	6.3	0.1
R6	3.9	2.0	10.0	0.1
R7	4.4	2.2	11.6	0.1
R8	4.6	2.3	10.8	0.1
R9	4.1	2.0	9.5	0.1
R10	3.6	1.8	9.5	0.1
R11	3.5	1.8	8.0	0.1
R12	3.7	1.8	8.8	0.1
R13	4.4	2.2	10.6	0.1
R14	5.7	2.8	16.5	0.2
R15	3.6	1.8	13.1	0.1
R16	4.8	2.4	8.9	0.1
R17	4.3	2.2	7.2	0.1
R18	3.5	1.7	7.3	0.1
R19	3.1	1.6	6.4	0.1
R20	3.7	1.8	9.7	0.1
Screening Criteria	**20**	**10**	**1,000**	**10**

Table 6.3.2: Short-term Results of Stack Modelling for Human Health Sensitive Receptors, with Covanta

ID	Nitrogen Dioxide (NO$_2$)		Carbon Monoxide (CO)	
	PEC (µg/m^3)	Percentage of EAL (%)	Running 8 hour mean PEC (µg/m^3)	Percentage of EAL (%)
R1	32.5	16.3	617.2	6.2
R2	33.1	16.5	620.9	6.2
R3	32.9	16.5	617.1	6.2
R4	33.1	16.5	620.7	6.2
R5	25.4	12.7	606.3	6.1
R6	27.6	13.8	610.0	6.1
R7	28.0	14.0	611.6	6.1
R8	30.5	15.2	610.8	6.1
R9	27.6	13.8	609.5	6.1
R10	29.8	14.9	609.5	6.1
R11	29.1	14.6	608.0	6.1
R12	29.3	14.6	608.8	6.1
R13	29.7	14.8	610.6	6.1
R14	29.0	14.5	616.5	6.2
R15	27.0	13.5	613.1	6.1
R16	32.8	16.4	608.9	6.1
R17	32.3	16.2	607.2	6.1
R18	29.3	14.6	607.3	6.1
R19	27.8	13.9	606.4	6.1
R20	27.2	13.6	609.7	6.1
Environmental Assessment Level	**200**	**100**	**10,000**	**100**

Table 6.3.3: Long-term Results of Stack Modelling for Human Health Sensitive Receptors, with Covanta

ID	Nitrogen Dioxide (NO$_2$)			
	Annual mean PC (µg/m³)	Percentage of EAL (%)	Annual mean PEC (µg/m³)	Percentage of EAL (%)
R1	0.19	0.5	13.7	34.2
R2	0.19	0.5	14.0	34.9
R3	0.20	0.5	14.0	35.0
R4	0.20	0.5	14.0	35.0
R5	0.06	0.2	11.3	28.3
R6	0.08	0.2	11.9	29.8
R7	0.09	0.2	11.9	29.7
R8	0.09	0.2	13.0	32.5
R9	0.08	0.2	11.9	29.6
R10	0.05	0.1	13.2	32.9
R11	0.04	0.1	12.8	32.1
R12	0.04	0.1	12.8	32.1
R13	0.04	0.1	12.6	31.6
R14	0.05	0.1	11.7	29.4
R15	0.03	0.1	11.7	29.3
R16	0.04	0.1	14.0	35.1
R17	0.03	0.1	14.0	35.1
R18	0.03	0.1	12.9	32.3
R19	0.03	0.1	12.4	30.9
R20	0.07	0.2	11.8	29.6
Criteria	**0.4**	**1**	**40**	**100**

Table 6.3.4: Long-term NO$_x$ Results of Stack Modelling for Ecological Receptors, with Covanta

ID	Habitat Type	Background Concentration (µg/m³)	Critical Level (µg/m³)	PC (µg/m³)	PC/CL (%)	PEC (µg/m³)	PEC/CL (%)
E1	Lowland mixed deciduous woodland	15.2	30	0.05	0.17%	15.28	50.9%
	Neutral grassland	15.2	30	0.05	0.17%	15.28	50.9%
E2	Lowland Heathlands	20.1	30	0.03	0.09%	20.10	67.0%
E3	Broadleaved, mixed and yew woodland	16.3	30	0.11	0.37%	16.41	54.7%
E4	Calcareous grassland	16.3	30	0.03	0.11%	16.33	54.4%
E5	Neutral grassland	16.4	30	0.01	0.05%	16.46	54.9%
E6	Broadleaved, mixed and yew woodland	20.1	30	0.03	0.11%	20.11	67.0%
E7	Neutral grassland	16.1	30	0.09	0.28%	16.22	54.1%
E8	Calcareous grassland	17.1	30	0.03	0.10%	17.16	57.2%
E9	Broadleaved, mixed and yew woodland	17.1	30	0.03	0.11%	17.16	57.2%
E10	Broadleaved, mixed and yew woodland	16.2	30	0.04	0.14%	16.23	54.1%
E11	Broadleaved, mixed and yew woodland	19.0	30	0.13	0.44%	19.14	63.8%
E12	Broadleaved, mixed and yew woodland	17.1	30	0.03	0.10%	17.15	57.2%
E13	Acid grassland	18.5	30	0.03	0.10%	18.50	61.7%
E14	Neutral grassland	21.2	30	0.03	0.09%	21.26	70.9%
E15	Neutral grassland	20.0	30	0.03	0.10%	20.08	66.9%

Table 6.3.5: Daily NOx Results of Stack Modelling for Ecological Receptors, with Covanta

ID	Habitat Type	Background Concentration (µg/m³)	Critical Level (µg/m³)	PC (µg/m³)	PC/CL (%)	PEC (µg/m³)	PEC/CL (%)
E1	Lowland mixed deciduous woodland	15.23	75	4.9	6.6%	20.2	26.9%
	Neutral grassland	15.23	75	4.9	6.6%	20.2	26.9%
E2	Lowland Heathlands	20.08	75	3.7	4.9%	23.8	31.7%
E3	Broadleaved, mixed and yew woodland	16.30	75	7.5	10.0%	23.8	31.7%
E4	Calcareous grassland	16.30	75	5.0	6.7%	21.3	28.4%
E5	Neutral grassland	16.44	75	3.7	5.0%	20.2	26.9%
E6	Broadleaved, mixed and yew woodland	20.08	75	6.0	8.0%	26.1	34.8%
E7	Neutral grassland	16.14	75	9.0	12.0%	25.1	33.5%
E8	Calcareous grassland	17.12	75	4.9	6.5%	22.0	29.4%
E9	Broadleaved, mixed and yew woodland	17.12	75	4.6	6.1%	21.7	29.0%
E10	Broadleaved, mixed and yew woodland	16.18	75	6.6	8.7%	22.7	30.3%
E11	Broadleaved, mixed and yew woodland	19.01	75	8.0	10.6/CL	27.0	36.0%
E12	Broadleaved, mixed and yew woodland	17.12	75	4.5	6.0%	21.6	28.8%
E13	Acid grassland	18.47	75	3.6	4.8%	22.1	29.4%
E14	Neutral grassland	21.23	75	4.0	5.4%	25.3	33.7%
E15	Neutral grassland	20.05	75	5.1	6.7%	25.1	33.5%

Table 6.3.6: Results of stack modelling for ecological sensitive receptors: nutrient nitrogen deposition, with Covanta

ID	Habitat Type	Background Deposition (kgN/ha/yr)	Critical Load (kgN/ha/yr) Lower	PC (kgN/ha/yr)	PC/CL (%) Lower	PEC (kgN/ha/yr)	PEC/CL (%) Lower
E1	Broadleaved, mixed and yew woodland	29.40	15	0.010	0.07%	29.41	**196.1%**
	Neutral grassland	17.20	20	0.005	0.03%	17.23	86.1%
E2	Lowland Heathlands	17.10	10	0.003	0.03%	17.08	**170.8%**
E3	Broadleaved, mixed and yew woodland	29.40	10	0.022	0.15%	29.42	**196.1%**
E4	Calcareous grassland	17.22	15	0.003	0.02%	17.22	**114.8%**
E5	Neutral grassland	17.22	20	0.001	0.01%	17.22	86.1%
E6	Broadleaved, mixed and yew woodland	29.12	10	0.006	0.06%	29.13	**291.3%**
E7	Neutral grassland	17.22	20	0.009	0.04%	17.23	86.1%
E8	Calcareous grassland	17.08	15	0.003	0.02%	17.08	**113.9%**
E9	Broadleaved, mixed and yew woodland	29.12	10	0.006	0.06%	29.13	**291.3%**
E10	Broadleaved, mixed and yew woodland	29.12	10	0.009	0.09%	29.13	**291.3%**
E11	Broadleaved, mixed and yew woodland	29.40	10	0.026	0.26%	29.43	**294.3%**
E12	Broadleaved, mixed and yew woodland	29.12	10	0.006	0.06%	29.13	**291.3%**
E13	Acid grassland	17.08	10	0.003	0.03%	17.08	**170.8%**
E14	Neutral grassland	17.08	20	0.003	0.01%	17.08	85.4%
E15	Neutral grassland	17.50	20	0.003	0.01%	17.50	87.5%

Table 6.3.7: Results of stack modelling for ecological sensitive receptors: acid deposition, with Covanta

ID	Habitat Type	Background Concentration (keqN/ha/yr)	Critical Load (keqN/ha/yr)	PC (keqN/ha/yr)	PC/CL (%)	PEC (keqN/ha/yr)	PEC/CL (%)
E1	Broadleaved, mixed and yew woodland	2.10	10.83	0.0007	0.007%	2.10	19.4%
	Neutral grassland	1.23	4.93	0.0004	0.007%	1.23	25.0%
E2	Lowland Heathlands	1.22	1.35	0.0002	0.015%	1.22	90.3%
E3	Broadleaved, mixed and yew woodland	2.10	10.83	0.0016	0.015%	2.10	19.4%
E4	Calcareous grassland	1.23	4.93	0.0002	0.005%	1.23	25.0%
E5	Neutral grassland	1.23	4.93	0.0001	0.002%	1.23	25.0%
E6	Broadleaved, mixed and yew woodland	2.08	1.10	0.0005	0.042%	2.08	**190.0%**
E7	Neutral grassland	1.23	4.93	0.0006	0.012%	1.23	25.0%
E8	Calcareous grassland	1.22	4.86	0.0002	0.005%	1.22	25.1%
E9	Broadleaved, mixed and yew woodland	2.08	1.10	0.0005	0.042%	2.08	**189.6%**
E10	Broadleaved, mixed and yew woodland	2.08	1.10	0.0006	0.057%	2.08	**189.5%**
E11	Broadleaved, mixed and yew woodland	2.10	10.81	0.0019	0.017%	2.10	19.4%
E12	Broadleaved, mixed and yew woodland	2.08	1.10	0.0004	0.039%	2.08	**189.6%**
E13	Acid grassland	1.22	0.68	0.0002	0.031%	1.22	**178.7%**
E14	Neutral grassland	1.22	4.93	0.0002	0.004%	1.22	24.8%
E15	Neutral grassland	1.25	5.07	0.0002	0.004%	1.25	24.7%