



**Document 3.1- ES Volume 2
Appendix 5.3 Stack Height
Determination**

**The Kemsley Mill K4 Combined Heat and
Power Generating Station Development
Consent Order**

**Planning Act 2008 The Infrastructure Planning
(Applications: Prescribed Forms and
Procedure) Regulations 2009
Regulation 5(2)q**

April 2018 - Submission Version

PINS Ref: EN010090

Appendix 5.3: Stack Height Determination

A stack height determination has been undertaken to establish the height at which there is minimal additional environmental benefit associated with the cost of further increasing the stack. The Environment Agency removed their detailed guidance, Horizontal Guidance Note EPR H1 [1], for undertaking risk assessments on 1 February 2016; however, the approach used here by RPS is consistent with that EA guidance which required the identification of *“an option that gives acceptable environmental performance but balances costs and benefits of implementing it.”*

The emissions data used in the stack height determination are summarised in Chapter 5: Air Quality, Section 5.3. Simulations have been run using ADMS 5 to determine what stack height is required to provide adequate dispersion/dilution and to overcome local building wake effects.

The stack height determination considers ground level concentrations over the averaging periods relevant to the air quality assessment, together with the full range of all likely meteorological conditions through the use of five years of hourly sequential meteorological data from Gravesend. The model was run for a range of stack heights between 50 m to 115 m, at 5 m increments.

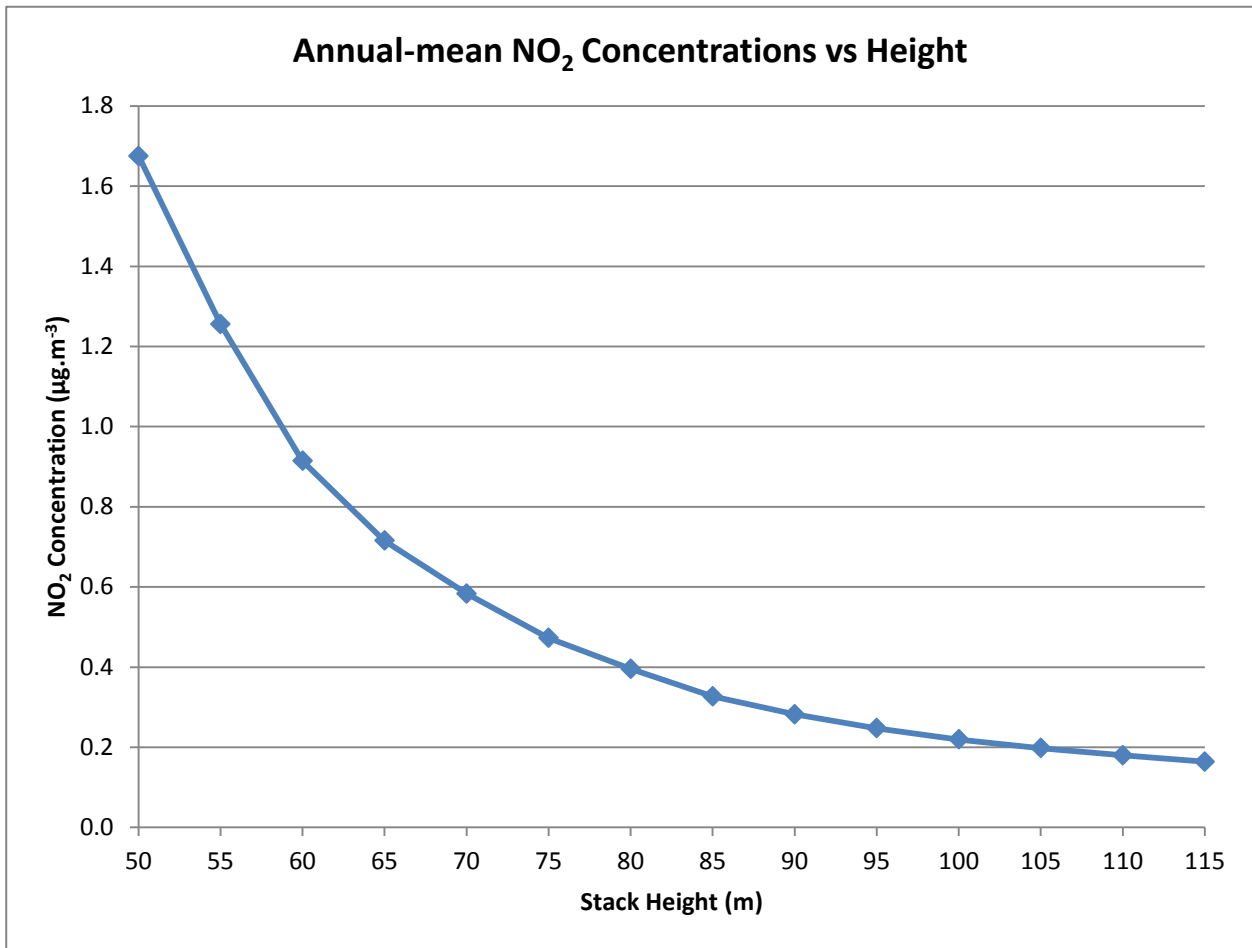
The dispersion modelling for the purposes of stack height determination assumed a domain of 20 km by 20 km centred on the proposed development and with a grid spacing of 200 m. Results have been reported for the location where the highest concentration is predicted. This is considered a robust and conservative approach.

The stack height modelling results have been analysed in two stages:

Stage 1 - As explained in Chapter 5: Air Quality, two stack layouts for the CHP have been modelled. The process contributions for stack location 1 have been plotted against height to determine if there is a height at which no benefit is gained from increases in stack heights.

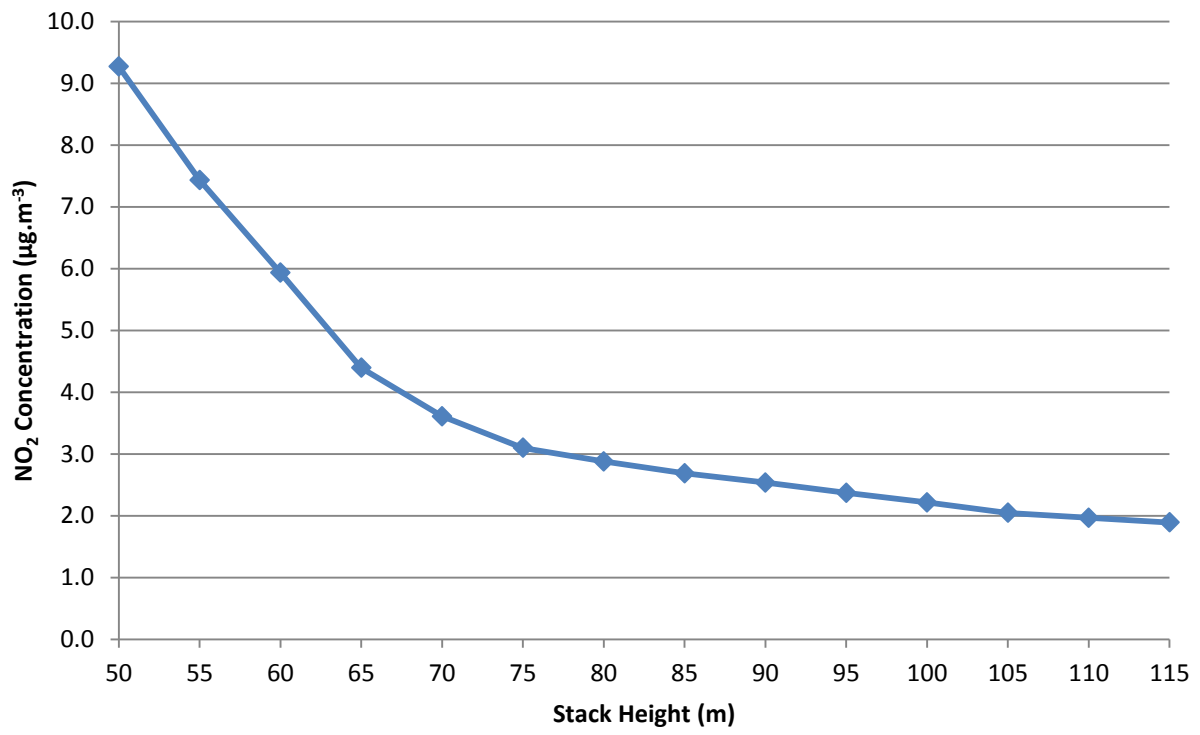
Graph B1 compares the maximum predicted annual-mean NO₂ process contribution with the stack heights modelled and Graph B2 compares the maximum predicted 99.79th percentile of hourly-mean NO₂ process contributions with the stack heights modelled. Graph 3 compares the maximum 8-hour running mean CO process contributions with the stack heights modelled.

Graph B1 – Maximum Predicted Annual-mean NO₂ Process Contributions (µg.m⁻³) Compared vs Stack Height (m)

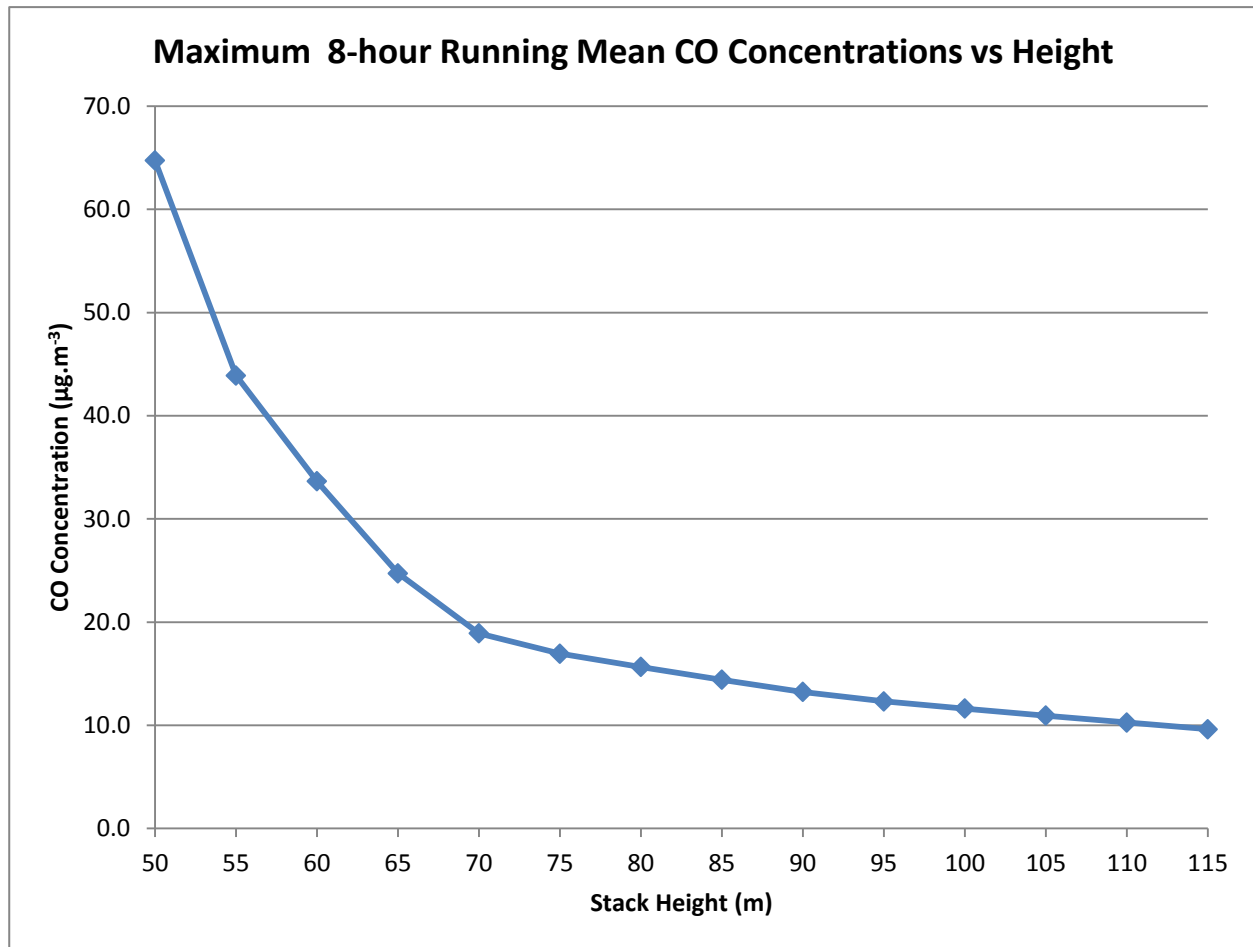


Graph B2 – Maximum Predicted 99.79th Percentile of Hourly-mean NO₂ Process Contributions (µg.m⁻³) Compared vs Stack Height (m)

99.79th Percentile of Hourly-mean NO₂ Concentrations vs Height



Graph B3 – Maximum 8 hour Running Mean CO Process Contributions ($\mu\text{g.m}^{-3}$) Compared vs Stack Height (m)



Graph B1 shows there is no height where ground-level Process Contribution level off within the range of heights considered. Graphs B2 and B3 indicate that the potential air quality benefits of increasing the stack height diminish significantly above 70 m.

Stage 2 - The lowest height at which the maximum long and short-term impacts across the grid are negligible has been determined.

Stack Height Determination Results

The maximum long and short-term impacts across the grid, for each height, are set out in Table B1, Table B2 and Table B3. The results presented are for stack location 1 with the results for stack location 2 shown in brackets.

Table B1 Maximum Impacts Across the Grid – Long-term NO_2

Height (m)	Annual Mean PC ($\mu\text{g.m}^{-3}$)	Annual- mean PC as %AQAL	Annual-mean PEC	Impact Descriptor
50	1.7 (1.8)	4 (4)	33.5 (33.7)	Slight

55	1.3 (1.3)	3 (3)	33.3 (33.3)	Slight
60	0.9 (1.0)	2 (2)	33.2 (33.2)	Slight
65	0.7 (0.7)	2 (2)	33.1 (33.2)	Slight
70	0.6 (0.6)	1 (2)	33.1 (33.1)	Negligible (Slight)
75	0.5 (0.5)	1 (1)	33.0 (33.0)	Negligible
80	0.4 (0.4)	1 (1)	33.0 (33.0)	Negligible
85	0.3 (0.3)	1 (1)	32.9 (33.0)	Negligible
90	0.3 (0.3)	1 (1)	32.9 (32.9)	Negligible
95	0.2 (0.2)	1 (1)	32.9 (32.9)	Negligible
100	0.2 (0.2)	1 (1)	32.9 (32.9)	Negligible
105	0.2 (0.2)	0 (0)	32.8 (32.8)	Negligible
110	0.2 (0.2)	0 (0)	32.8 (32.8)	Negligible
115	0.2 (0.2)	0 (0)	32.8 (32.8)	Negligible

AQAL for annual-mean NO₂ is 40 µg.m⁻³

Table B2 Maximum Impacts Across the Grid – Short-term NO₂

Height (m)	99.79 th Percentile of Hourly-mean PCs (µg.m ⁻³)	99.79 th Percentile of Hourly-mean PC as %AQAL	Impact Descriptor	99.79 th Percentile of Hourly-mean PEC	99.79 th Percentile of Hourly-mean PEC as % of AQAL
50	9.3 (10.8)	5 (5)	Negligible	76.9 (76.5)	38 (38)
55	7.4 (7.7)	4 (4)	Negligible	75.3 (75.2)	38 (38)
60	5.9 (5.9)	3 (3)	Negligible	74.7 (74.5)	37 (37)
65	4.4 (4.6)	2 (2)	Negligible	74.0 (73.9)	37 (37)
70	3.6 (3.8)	2 (2)	Negligible	73.3 (73.4)	37 (37)
75	3.1 (3.1)	2 (2)	Negligible	73.3 (73.3)	37 (37)
80	2.9 (2.9)	1 (1)	Negligible	73.2 (73.2)	37 (37)
85	2.7 (2.7)	1 (1)	Negligible	73.2 (73.2)	37 (37)
90	2.5 (2.5)	1 (1)	Negligible	73.1 (73.1)	37 (37)
95	2.4 (2.3)	1 (1)	Negligible	73.0 (73.0)	37 (37)
100	2.2 (2.2)	1 (1)	Negligible	72.9 (72.9)	36 (36)
105	2.0 (2.1)	1 (1)	Negligible	72.9 (72.9)	36 (36)
110	2.0 (2.0)	1 (1)	Negligible	72.8 (72.8)	36 (36)
115	1.9 (1.9)	1 (1)	Negligible	72.8 (72.8)	36 (36)

AQAL for 99.79th hourly-mean NO₂ is 200 µg.m⁻³

Table B3 Maximum Impacts Across the Grid – Short-term CO

Height (m)	Maximum 8-hour running mean PCs (µg.m ⁻³)	Maximum 8-hour running mean PC as %AQAL	Impact Descriptor
50	64.7 (64.5)	6 (6)	Negligible
55	43.9 (46.7)	4 (5)	Negligible
60	33.6 (35.3)	3 (4)	Negligible
65	24.7 (25.3)	2 (3)	Negligible

70	18.9 (20.0)	2 (2)	Negligible
75	16.9 (17.3)	2 (2)	Negligible
80	15.6 (15.5)	2 (2)	Negligible
85	14.4 (14.2)	1 (1)	Negligible
90	13.2 (13.1)	1 (1)	Negligible
95	12.3 (12.4)	1 (1)	Negligible
100	11.6 (11.7)	1 (1)	Negligible
105	10.9 (11.0)	1 (1)	Negligible
110	10.3 (10.3)	1 (1)	Negligible
115	9.6 (9.6)	1 (1)	Negligible

AQAL for maximum 8-hour CO is 10,000 $\mu\text{g.m}^{-3}$

For stack location 1, the maximum long-term impacts across the grid are slight adverse at heights between 50 m and 65 m and negligible at 70 m and above. For stack location 2, the maximum long-term impacts across the grid are slight adverse at heights between 50 m and 70 m and negligible at 75 m and above. For the short-term impacts, the maximum impacts across the grid are negligible at all heights.

A suitable stack height for the development is therefore considered to be 70 m.

Conclusion

Based on the results of the detailed stack height modelling and using professional judgement, a suitable stack height for the assessment is considered to 70 m and the detailed modelling undertaken in this report assumes a 70 m high stack.

1 Environment Agency (2010) Environmental Permitting Regulations (EPR) – H1 Environmental Risk Assessment, Annex K