NSW GOVERNMENT

Roads and Maritime Services

F6 Extension Stage 1

New M5 Motorway at Arncliffe to President Avenue at Kogarah

Submissions report

Appendix A
Submitter identification number reference table

Contents

Submitter identification number reference table

Issues raised in submissions from community groups, individual community members and other stakeholders have been grouped into common issues, which are described in this appendix. Submitters can locate the issues raised in their submissions and the relevant section of the report where these have been addressed. Each submission author has been assigned a submitter identification number based on their submission form number assigned by the NSW Department of Planning and Environment (DP&E) on receipt of the submission. A submitter can access their submitter identification number by locating their submission on the NSW Major Projects website[1].

Where a submitter has provided additional comments within a form letter, those additional comments are represented by the submitter identification number and cross referenced against the relevant responses in this appendix.

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[1] http://majorprojects.planning.nsw.gov.au

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NSW GOVERNMENT

Roads and Maritime Services

F6 Extension Stage 1

New M5 Motorway at Arncliffe to President Avenue at Kogarah

Submissions report

Appendix B
Air quality impacts for elevated receptors

Air quality impacts for elevated receptors

This chapter addresses issues raised in the submission from the NSW Environment Protection Authority (NSW EPA). The submissions text is included verbatim. However, editorial amendments to clarify text, where required, are provided as strikethrough (for text deletion) or in square brackets (for text insertion).

Contents

1.0 Introduction

This appendix is to be read alongside **section 2.3.3** of the Submissions report (SR), which provides a response to queries raised in NSW Environment Protection Authority (NSW EPA) submission for the project which relate to potential air quality impacts to elevated receptors.

The relevant section of the NSW EPA submission is reproduced in **section 2.0**. A response to the queries is provided in detail in **section 3.0** and a summary of this response is provided in **section 2.3.3** of the SPIR.

2.0 Assessment of impacts at elevated receptors (NSW EPA)

Assessment of impacts at elevated receptors has only been considered for $PM_{2.5}$ for the 2036-DSC scenario and there is a lack of clarity on the existence of receptors at a height where notable increases in pollutant concentrations are predicted.

The Air Quality Technical Report assesses the potential impacts at additional heights above ground level (heights of 10, 20, 30 and 45 metres). The assessment of impacts at height are conducted for annual average $PM_{2.5}$ and 24-hour average $PM_{2.5}$, for the 2036-DSC scenario and does not include existing background. The predictions are presented in concentration changes.

The Air Quality Technical Report advises that:

- *'some of the buildings in the general areas around the F6 Arncliffe and Rockdale ventilation outlets were taller than 30 metres'*
- *'the available information on building height was approximate (and incomplete)'; and*
- *'there were significant gaps in the building height data for the subset of RWR receptors'*

The Air Quality Technical Report predicts, a noticeable change in concentration for a receptor height of 45 metres for both annual average and 24-hour average $PM_{2.5}$.

Based on the information provided, it appears that there are no receptors at a height where a noticeable increase in concentration for $PM_{2.5}$ is predicted. However, the Technical Report advises that there are data gaps in building height information. Further, assessment for other pollutants and averaging times has not been conducted.

It is recommended that the 'proponent:

- *Confirm receptor heights located in proximity to ventilation outlets given the significant data gaps on building height described within the Air Quality Technical Report;*
- *Present predicted impacts for all pollutants and averaging periods for receptors located at height in proximity to ventilation outlets. This includes 1-hour average air toxics and for relevant pollutants accounting for background air quality;*
- *Present predicted impacts for all pollutants and averaging periods for receptors located at height in proximity to ventilation outlets, for the regulatory worst-case scenario.*

3.0 Response

3.1 Receptor heights in proximity to ventilation outlets

Receptor heights in proximity to ventilation outlets are summarised below:

- Land in the immediate vicinity of the Rockdale ventilation facility is zoned industrial with a building height limit of 14.5 metres in the Rockdale Local Environmental Plan (LEP) 2011. The low density zoned residential land which surrounds the industrial zoned land has a building height limit of 8.5 metres. At this height there would be minimal influence from the ventilation outlets and the local air quality is influenced by emissions from the surface road which diminishes at heights towards 10 metres.
- A high density residential zoned area with a building height provision of 14.5 metres is located approximately 250 metres to the west of the ventilation facility. Another high density zoned

residential area with a building height limit of 31 metres is located approximately 450 metres to the northwest of the site

- Land in the immediate vicinity of the Arncliffe ventilation facility is regulated under the Rockdale LEP 2011 and SREP 33. The areas to the site's immediate north and north east are zoned for low density residential development and have maximum building heights of 8.5 metres. At this height there is minimal influence from the ventilation outlets and the local air quality is influenced by emissions from the surface road which diminishes at heights towards 10 metres
- North of the Arncliffe ventilation facility towards Cahill Park, building heights are significantly higher and range between 17.5 metres and 29.5 metres in the high density residential zoned area and 46 metres in the mixed use zoned areas. This area is located approximately 260 metres away (at its closest point). The closest elevated receptors to the Arncliffe ventilation facility are in the area bounded by Marsh Street, Innesdale Road and Levey Street, approximately 240 metres away and the receptors in these buildings are lower than the 46 metres mixed use height restriction in the LEP.

3.2 Predicted impacts for all pollutants for receptors located at height in proximity to ventilation outlets

The reasons for the focus on the PM2.5 increment in the 2036-DSC scenario are given on page 8-32 of the Air Quality Technical Report:

'The focus was on the changes in annual average and maximum 24-hour PM2.5 concentrations in the 2036-DSC scenario (assumed to be the worst case scenario). Background concentrations were not taken into account, as these could not be quantified at elevated locations. This also precluded the assessment of NO2, as NO2 formation was calculated using total NOX. Only the changes in the PM2.5 concentration are therefore presented in the report.'

For this report, additional work has been undertaken to estimate the incremental changes for all relevant pollutants and averaging periods at existing elevated locations in the expected traffic scenario 2036-DSC. As in the Air Quality Technical Report, concentration increments were determined by subtracting the modelled concentrations for surface roads and ventilation outlets in the 2036-DM scenario from those in the 2036-DSC scenario. As noted above, background concentrations are not measured at elevated locations. They were therefore not known and could not sensibly be incorporated. This also meant that NO2 concentrations could not be determined accurately.

As only PM2.5 concentrations (annual mean and maximum 24-hour) were modelled at elevated locations, the values for other pollutant metrics were determined using a scaling approach. The approach took into account the specific RWR receptors associated with existing tall buildings near the Arncliffe and Rockdale ventilation outlets.

The following steps were taken:

(a) Existing tall buildings in the proximity of the tunnel ventilation outlets were identified. The RWR receptors identified with these buildings are shown in **Figure 1** and **Figure 2**.

Then, for each of the specific RWR receptors in **Figure 1** and **Figure 2**:

(b) Maximum 1-hour concentration increments for PM2.5 were modelled for ground level, 10 metres, 20 metres, 30 metres and 45 metres (as noted above, annual mean and maximum 24-hour PM2.5 concentrations were already available).

(c) For PM2.5 at each height a scaling factor (relative to ground level) was determined by dividing the predicted concentration increment at the relevant height by the predicted concentration increment at ground level (an example for one of the receptors is given in **Table 1**). Separate scaling factors were determined for the different averaging periods.

(d) The ratios from step (c) were applied to the concentration increments at ground level for the other pollutants to estimate the concentration increments for the other pollutants at elevated locations.

For criteria pollutants the resulting concentrations are presented in **Table 2** and the results for specific air toxics are given in **Table 3**.

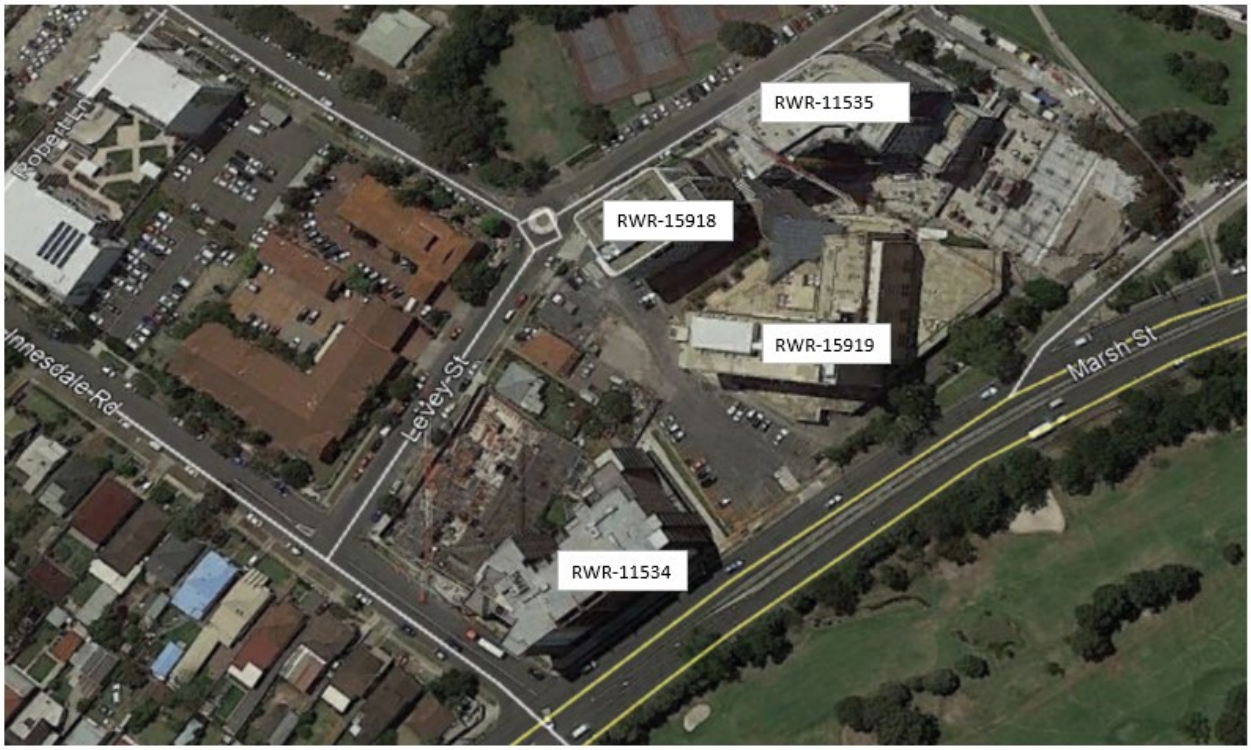

Figure 1 RWR receptors for existing tall buildings to the north-east of the Arncliffe ventilation outlet

Figure 2 RWR receptors for existing tall buildings at Rockdale Plaza, to the north-west of the Rockdale ventilation outlet

Table 1 Height scaling factors for PM2.5, expected traffic (applicable to change in concentration) – example for RWR-11534

Height	Annual mean scaling factors	Maximum 24 hour scaling factors	Maximum 1 hour scaling factors	Height
Ground level	1.00	1.00	1.00	Ground level
10 m	-0.26	-0.86	-0.30	10 m
20 m	0.11	0.26	0.18	20 m
30 m	-0.17	4.33	0.35	30 m
45 m	-0.47	2.20	0.27	45 m

Table 2 Estimated concentration increments (expected traffic, 2036-DSC minus 2036-DM) at RWR receptors - criteria pollutants

Pollutant	Period	Units	Height	Criterion	Concentration increment [(a)]								
					Arncliffe				Rockdale				
					RWR-11534	RWR-11535	RWR-15918	RWR-15919	RWR-00392	RWR-06701	RWR-06702	RWR-06703	RWR-11493
CO	Max. 1h	mg/m³	Ground	30	**-0.23**	**-0.06**	**-0.16**	**-0.26**	**-0.03**	**-0.09**	**-0.04**	**-0.13**	**-0.01**
			10 m		*0.07*	*0.18*	*-0.11*	*-0.27*	*0.03*	*-0.22*	*0.01*	*-0.06*	*-0.09*
			20 m		*-0.04*	*0.16*	*-0.35*	*0.24*	*0.01*	*-0.11*	*0.00*	*-0.03*	*0.00*
			30 m		*-0.08*	*0.02*	*-0.08*	*-0.04*	*-0.01*	*-0.01*	*-0.02*	*-0.06*	*0.26*
			45 m		*-0.06*	*0.08*	*0.06*	*-0.25*	*0.00*	*0.00*	*0.01*	*0.04*	*0.02*
NO_X	Annual	µg/m³	Ground	62 (NO_2)	**-3.53**	**-1.84**	**-1.62**	**-2.71**	**-0.54**	**-0.44**	**-0.09**	**-1.29**	**-1.89**
			10 m		*0.91*	*-7.74*	*-2.27*	*-1.10*	*0.32*	*0.35*	*0.12*	*2.69*	*-1.20*
			20 m		*-0.39*	*3.81*	*-1.24*	*-0.71*	*1.11*	*0.73*	*0.11*	*-0.69*	*0.98*
			30 m		*0.58*	*0.96*	*-0.03*	*0.18*	*2.12*	*1.28*	*0.23*	*0.77*	*0.60*
			45 m		*1.65*	*2.75*	*0.96*	*0.26*	*1.18*	*1.33*	*0.25*	*-8.38*	*0.32*
	Max. 1h	µg/m³	Ground	246 (NO_2)	**-228.7**	**-125.7**	**-88.2**	**-190.3**	**10.3**	**-17.1**	**47.9**	**-133.0**	**-44.8**
			10 m		*69.3*	*352.2*	*-58.4*	*-196.0*	*-11.9*	*-41.5*	*-7.5*	*-65.5*	*-312.6*
			20 m		*-41.1*	*325.5*	*-190.8*	*170.9*	*-3.4*	*-20.4*	*-2.7*	*-32.7*	*7.4*
			30 m		*-80.4*	*36.9*	*-43.8*	*-31.7*	*2.1*	*-1.2*	*25.9*	*-58.4*	*874.2*
			45 m		*-61.0*	*167.4*	*33.8*	*-179.9*	*-0.3*	*0.1*	*-7.0*	*39.4*	*65.8*
PM_{10}	Annual	µg/m³	Ground	25	**-0.11**	**-0.10**	**-0.15**	**-0.05**	**-0.04**	**-0.11**	**0.03**	**-0.14**	**-0.25**
			10 m		*0.03*	*-0.42*	*-0.21*	*-0.02*	*0.02*	*0.09*	*-0.04*	*0.29*	*-0.16*
			20 m		*-0.01*	*0.21*	*-0.12*	*-0.01*	*0.08*	*0.18*	*-0.03*	*-0.07*	*0.13*
			30 m		*0.02*	*0.05*	*0.00*	*0.00*	*0.15*	*0.32*	*-0.07*	*0.08*	*0.08*
			45 m		*0.05*	*0.15*	*0.09*	*0.01*	*0.09*	*0.33*	*-0.08*	*-0.89*	*0.04*
	Max. 24h	µg/m³	Ground	50	**-0.67**	**-0.42**	**-0.51**	**0.01**	**-0.49**	**-0.01**	**-0.11**	**-0.18**	**-0.83**
			10 m		*0.57*	*0.82*	*-3.31*	*0.00*	*-0.23*	*0.00*	*-0.13*	*0.91*	*-1.17*
			20 m		*-0.17*	*0.23*	*-1.44*	*0.00*	*-0.19*	*0.00*	*-0.04*	*1.38*	*0.02*
			30 m		*-2.90*	*-0.05*	*-0.93*	*0.00*	*-0.08*	*0.00*	*-0.03*	*3.01*	*0.04*
			45 m		*-1.47*	*0.02*	*-1.20*	*0.00*	*-0.05*	*0.00*	*0.01*	*-1.14*	*-0.29*
$PM_{2.5}$	Annual	µg/m³	Ground	8	**-0.09**	**-0.01**	**-0.05**	**-0.16**	**-0.02**	**-0.02**	**-0.02**	**0.01**	**-0.10**
			10 m		**0.02**	**-0.05**	**-0.08**	**-0.07**	**0.01**	**0.02**	**0.03**	**-0.01**	**-0.06**
			20 m		**-0.01**	**0.02**	**-0.04**	**-0.04**	**0.04**	**0.04**	**0.02**	**0.00**	**0.05**
			30 m		**0.02**	**0.01**	**0.00**	**0.01**	**0.08**	**0.07**	**0.05**	**0.00**	**0.03**
			45 m		**0.04**	**0.02**	**0.03**	**0.02**	**0.04**	**0.08**	**0.05**	**0.04**	**0.02**
	Max. 24h	µg/m³	Ground	25	**-0.11**	**0.16**	**-0.07**	**-0.53**	**-0.27**	**-0.34**	**-0.33**	**0.02**	**-0.38**
			10 m		**0.09**	**-0.31**	**-0.46**	**-0.08**	**-0.13**	**-0.15**	**-0.38**	**-0.08**	**-0.54**
			20 m		**-0.03**	**-0.09**	**-0.20**	**-0.27**	**-0.10**	**-0.11**	**-0.11**	**-0.12**	**0.01**
			30 m		**-0.45**	**0.02**	**-0.13**	**0.10**	**-0.05**	**-0.15**	**-0.09**	**-0.26**	**0.02**
			45 m		**-0.23**	**-0.01**	**-0.17**	**-0.03**	**-0.03**	**0.15**	**0.04**	**0.10**	**-0.14**

(a) Figures in bold were modelled in the original air quality assessment. Figures in italics have been estimated for this report using an emission scaling approach.
(b) Corrected value (incorrectly given as 0.45 in Table 8-22 of the air quality report).

Table 3 Estimated concentration increments (expected traffic, 2036-DSC minus 2036-DM) at RWR receptors - air toxics

Pollutant	Period	Units	Height	Criterion	Concentration increment [(a)]								
					Arncliffe				Rockdale				
					RWR-11534	RWR-11535	RWR-15918	RWR-15919	RWR-00392	RWR-06701	RWR-06702	RWR-06703	RWR-11493
Benzene	**Max. 1h**	**µg/m³**	**Ground**		**-0.52**	**-0.27**	**-0.43**	**-0.59**	**0.10**	**-0.05**	**0.03**	**0.11**	**-0.28**
			10 m		*0.16*	*0.75*	*-0.28*	*-0.61*	*-0.11*	*-0.13*	*0.00*	*0.05*	*-1.94*
			20 m	**29**	*-0.09*	*0.69*	*-0.93*	*0.53*	*-0.03*	*-0.06*	*0.00*	*0.03*	*0.05*
			30 m		*-0.18*	*0.08*	*-0.21*	*-0.10*	*0.02*	*0.00*	*0.02*	*0.05*	*5.42*
			45 m		*-0.14*	*0.36*	*0.16*	*-0.56*	*0.00*	*0.00*	*0.00*	*-0.03*	*0.41*
PAHs (as b(a)p)	**Max. 1h**	**µg/m³**	**Ground**		**-0.006**	**-0.003**	**-0.005**	**-0.007**	**0.001**	**-0.001**	**0.000**	**0.001**	**-0.003**
			10 m		*0.002*	*0.009*	*-0.004*	*-0.008*	*-0.001*	*-0.002*	*0.000*	*0.001*	*-0.024*
			20 m	**0.4**	*-0.001*	*0.009*	*-0.012*	*0.007*	*0.000*	*-0.001*	*0.000*	*0.000*	*0.001*
			30 m		*-0.002*	*0.001*	*-0.003*	*-0.001*	*0.000*	*0.000*	*0.000*	*0.001*	*0.068*
			45 m		*-0.002*	*0.004*	*0.002*	*-0.007*	*0.000*	*0.000*	*0.000*	*0.000*	*0.005*
Formaldehyde	**Max. 1h**	**µg/m³**	**Ground**		**-0.68**	**-0.35**	**-0.56**	**-0.77**	**0.13**	**-0.07**	**0.04**	**0.14**	**-0.36**
			10 m		*0.21*	*0.98*	*-0.37*	*-0.79*	*-0.15*	*-0.16*	*-0.01*	*0.07*	*-2.52*
			20 m	**20**	*-0.12*	*0.90*	*-1.20*	*0.69*	*-0.04*	*-0.08*	*0.00*	*0.03*	*0.06*
			30 m		*-0.24*	*0.10*	*-0.28*	*-0.13*	*0.03*	*0.00*	*0.02*	*0.06*	*7.05*
			45 m		*-0.18*	*0.46*	*0.21*	*-0.73*	*0.00*	*0.00*	*-0.01*	*-0.04*	*0.53*
1,3-butadiene	**Max. 1h**	**µg/m³**	**Ground**		**-0.14**	**-0.07**	**-0.12**	**-0.16**	**0.03**	**-0.01**	**0.01**	**0.03**	**-0.08**
			10 m		*0.04*	*0.21*	*-0.08*	*-0.17*	*-0.03*	*-0.03*	*0.00*	*0.01*	*-0.53*
			20 m	**40**	*-0.03*	*0.19*	*-0.25*	*0.15*	*-0.01*	*-0.02*	*0.00*	*0.01*	*0.01*
			30 m		*-0.05*	*0.02*	*-0.06*	*-0.03*	*0.01*	*0.00*	*0.00*	*0.01*	*1.48*
			45 m		*-0.04*	*0.10*	*0.04*	*-0.15*	*0.00*	*0.00*	*0.00*	*-0.01*	*0.11*
Ethylbenzene	**Max. 1h**	**µg/m³**	**Ground**		**-0.17**	**-0.09**	**-0.14**	**-0.19**	**0.03**	**-0.02**	**0.01**	**0.03**	**-0.09**
			10 m		*0.05*	*0.25*	*-0.09*	*-0.20*	*-0.04*	*-0.04*	*0.00*	*0.02*	*-0.64*
			20 m	**8,000**	*-0.03*	*0.23*	*-0.30*	*0.17*	*-0.01*	*-0.02*	*0.00*	*0.01*	*0.02*
			30 m		*-0.06*	*0.03*	*-0.07*	*-0.03*	*0.01*	*0.00*	*0.01*	*0.02*	*1.78*
			45 m		*-0.05*	*0.12*	*0.05*	*-0.18*	*0.00*	*0.00*	*0.00*	*-0.01*	*0.13*

(a) Figures in bold were modelled in the original air quality assessment. Figures in italics have been estimated for this report using an emission scaling approach.

At the existing tall buildings there was, in many cases, a negative concentration increment.

Where there was predicted to be an positive concentration increment for the existing tall buildings, the largest values were generally at a height of 30 metres or 45 metres.

These largest positive increments were:

- 0.26 mg/m3 for maximum 1-hour CO, or 0.9 per cent of the criterion.
- 0.08 µg/m3 for annual mean PM2.5, or 0.9 per cent of the criterion.
- 0.16 µg/m3 for maximum 24-hour PM2.5, or 0.6 per cent of the criterion.

The results for annual mean PM2.5 indicate that, for all existing tall buildings near the ventilation outlets, the concentration increments at heights of up to 45 metres above ground level were well below the criterion for ΔPM2.5 of 1.8 µg/m3.

For NO2 the concentration increment could not be known accurately. For NOX the largest predicted increments were:

- 3.8 µg/m3 for annual mean NOX
- 874 µg/m3 for maximum 1-hour NOX (at a height of 30 metres)

There is considerable uncertainty in the estimated 1-hour NOX concentration, which is the product of a negative ground-level increment and a negative height scaling factor. Assuming a maximum 1-hour background NOX concentration of 589 µg/m3 (as used for RWR receptors at ground level) at this location and height, and therefore a total NOX concentration of 1,463 µg/m3, the resulting NO2/NOX ratio would be 0.16 and the total NO2 concentration would be 234.1 µg/m3. This is still below the criterion of 246 µg/m3. In reality, the background NOX concentration at a height of 30 metres would probably be somewhat lower than at ground level.

With respect to air toxics the largest predicted (positive) increments, which all occurred at a height of 30 metres, were as follows:

- Benzene, maximum 1-hour concentration of 5.4 µg/m3, or 19 per cent of the criterion.
- PAHs (as b(a)p) , maximum 1-hour concentration of 0.07 µg/m3, or 17 per cent of the criterion.
- Formaldehyde, maximum 1-hour concentration of 7.0 µg/m3, or 35 per cent of the criterion.
- 1,3-butadiene, maximum 1-hour concentration of 1.5 µg/m3, or 3.7 per cent of the criterion.
- Ethylbenzene, maximum 1-hour concentration of 1.8 µg/m3, or 0.02 per cent of the criterion.

No data were available to enable background 1-hour concentrations of air toxics to be determined.

3.3 Regulatory worst case scenario

In the Air Quality Technical Report, pollutant concentrations in the regulatory worst case scenario (ventilation outlet contributions only) were modelled for ground level. For this report, additional work has been undertaken to estimate the outlet contributions at elevated locations. The work focussed on the specific RWR receptors associated with existing tall buildings near the Rockdale and Arncliffe ventilation outlets, and covered all relevant pollutants and averaging periods.

Concentrations were estimated using a scaling approach, which involved the following steps:

(a) Existing tall buildings in the proximity of the tunnel ventilation outlets were identified. The RWR receptors identified with these buildings are shown in **Figure 1** and **Figure 2**.

(b) Then, for each of these receptors and for each averaging period (annual, maximum 24-hour and maximum 1-hour):

(c) For the expected traffic scenario 2036-DSC, the outlet contributions to PM2.5 were extracted for ground level, 10 metres, 20 metres, 30 metres and 45 metres.

(d) The ratio between the PM2.5 concentration at ground level in the regulatory worst case scenario and the PM2.5 concentration at ground level in the expected traffic scenario was determined (an example for one of the receptors is given in **Table 4**). For each averaging period it was assumed that this ratio would be applicable at all heights.

(e) For each elevated location, the ratio from step (c) was multiplied by the PM2.5 concentration from the expected traffic scenario to estimate regulatory worst case PM2.5 concentrations at elevated receptors.

(f) For PM2.5 a scaling factor for each height was determined by dividing the predicted outlet contribution at the height by the predicted outlet contribution at ground level (an example for one of the receptors is given in **Table 5**).

(g) For each of the specific RWR receptors in **Figure 1** and **Figure 2**, the height scaling factors from step (e) were applied to the concentrations of other pollutants at ground level to estimate the concentrations of the other pollutants at elevated locations.

Table 4 Regulatory worst case: expected traffic ratios for $PM_{2.5}$ – example for RWR-11534

	Ratio (regulatory worst case concentration: expected traffic		
Height	**Annual mean**	**Maximum 24 hour**	**Maximum 1 hour**
Ground level	8.33	9.65	4.85

Table 5 Height scaling factors for $PM_{2.5}$, regulatory worst case scenario (applicable to ventilation outlet contribution) – example for RWR-11534

Height	Annual mean scaling factors	Maximum 24 hour scaling factors	Maximum 1 hour scaling factors
Ground level	1.00	1.00	1.00
10 m	1.08	1.10	1.04
20 m	1.26	1.58	1.14
30 m	1.58	2.53	1.75
45 m	1.81	3.41	3.17

For criteria pollutants the resulting concentrations are presented in **Table 6**, and the results for specific air toxics are given in **Table 7**.

Table 6 Estimated concentration increments (regulatory worst case, 2036-DSC) at RWR receptors - criteria pollutants

Pollutant	Period	Units	Height	Criterion	Ventilation outlet contribution [a]								
					Arncliffe				Rockdale				
					RWR-11534	RWR-11535	RWR-15918	RWR-15919	RWR-00392	RWR-06701	RWR-06702	RWR-06703	RWR-11493
CO	Max. 1h	mg/m^3	Ground	30	**0.26**	**0.20**	**0.25**	**0.27**	**0.23**	**0.22**	**0.22**	**0.26**	**0.25**
			10 m		*0.27*	*0.17*	*0.27*	*0.29*	*0.20*	*0.22*	*0.22*	*0.28*	*0.21*
			20 m		*0.29*	*0.19*	*0.30*	*0.33*	*0.26*	*0.26*	*0.23*	*0.25*	*0.27*
			30 m		*0.45*	*0.21*	*0.28*	*0.31*	*0.22*	*0.25*	*0.24*	*0.26*	*0.23*
			45 m		*0.82*	*0.24*	*0.40*	*0.40*	*0.27*	*0.27*	*0.25*	*0.26*	*0.28*
NO_X	Annual	µg/m^3	Ground	62 (NO_2)	**7.30**	**7.77**	**8.04**	**7.56**	**7.48**	**6.46**	**7.15**	**6.01**	**5.98**
			10 m		*7.86*	*8.13*	*8.49*	*7.85*	*7.56*	*7.04*	*7.68*	*6.16*	*6.40*
			20 m		*9.19*	*8.72*	*9.30*	*8.96*	*8.50*	*7.44*	*8.29*	*6.49*	*6.77*
			30 m		*11.51*	*9.04*	*10.60*	*9.64*	*8.68*	*7.42*	*8.73*	*6.86*	*6.61*
			45 m		*13.22*	*9.64*	*11.15*	*10.36*	*9.13*	*7.65*	*8.69*	*6.78*	*6.68*
	Max. 1h	µg/m^3	Ground	246 (NO_2)	**120.2**	**109.0**	**115.4**	**121.7**	**125.2**	**102.3**	**103.8**	**110.7**	**127.0**
			10 m		*124.7*	*94.8*	*126.4*	*130.9*	*107.0*	*104.3*	*106.3*	*120.4*	*108.5*
			20 m		*137.4*	*105.9*	*142.1*	*149.8*	*136.8*	*122.9*	*109.1*	*109.5*	*138.7*
			30 m		*210.8*	*113.3*	*133.1*	*143.5*	*119.3*	*115.7*	*116.8*	*111.2*	*120.9*
			45 m		*381.6*	*129.3*	*189.1*	*183.0*	*142.0*	*126.6*	*117.9*	*110.5*	*144.0*
PM_{10} or $PM_{2.5}$	Annual	µg/m^3	Ground	25 (PM_{10}) 8 ($PM_{2.5}$)	**0.41**	**0.43**	**0.45**	**0.41**	**0.41**	**0.36**	**0.39**	**0.34**	**0.33**
			10 m		*0.44*	*0.45*	*0.47*	*0.43*	*0.42*	*0.39*	*0.42*	*0.35*	*0.36*
			20 m		*0.52*	*0.48*	*0.52*	*0.49*	*0.47*	*0.41*	*0.46*	*0.37*	*0.38*
			30 m		*0.65*	*0.50*	*0.59*	*0.52*	*0.48*	*0.41*	*0.48*	*0.39*	*0.37*
			45 m		*0.74*	*0.53*	*0.62*	*0.56*	*0.50*	*0.43*	*0.48*	*0.39*	*0.37*
	Max. 24h	µg/m^3	Ground	50 (PM_{10}) 25 ($PM_{2.5}$)	**1.94**	**2.35**	**2.49**	**2.16**	**1.63**	**1.98**	**1.81**	**1.73**	**1.78**
			10 m		*2.13*	*2.48*	*2.44*	*2.59*	*1.67*	*2.14*	*1.91*	*1.77*	*1.81*
			20 m		*3.06*	*2.85*	*3.03*	*2.71*	*1.88*	*2.31*	*1.95*	*1.84*	*1.73*
			30 m		*4.90*	*3.13*	*3.51*	*3.37*	*2.05*	*2.12*	*2.01*	*2.03*	*1.80*
			45 m		*6.61*	*3.54*	*4.06*	*4.27*	*2.05*	*2.10*	*1.87*	*1.96*	*1.85*

(a) Figures in bold were modelled in the original air quality assessment. Figures in italics have been estimated for this report using an emission scaling approach.

Table 7 Estimated concentration increments (regulatory worst case, 2036-DSC) at RWR receptors - air toxics

Pollutant	Period	Units	Height	Criterion	Ventilation outlet contribution increment [(a)]								
					Arncliffe				Rockdale				
					RWR-11534	RWR-11535	RWR-15918	RWR-15919	RWR-00392	RWR-06701	RWR-06702	RWR-06703	RWR-11493
Benzene	**Max. 1h**	**µg/m³**	**Ground**		**1.04**	**0.76**	**0.82**	**0.87**	**0.82**	**0.79**	**0.91**	**0.85**	**0.73**
			10 m		*1.08*	*0.66*	*0.90*	*0.94*	*0.70*	*0.81*	*0.93*	*0.93*	*0.62*
			20 m	**29**	*1.19*	*0.74*	*1.01*	*1.07*	*0.90*	*0.95*	*0.96*	*0.84*	*0.79*
			30 m		*1.83*	*0.79*	*0.95*	*1.03*	*0.78*	*0.90*	*1.03*	*0.85*	*0.69*
			45 m		*3.31*	*0.90*	*1.35*	*1.31*	*0.93*	*0.98*	*1.04*	*0.85*	*0.82*
PAHs (as b(a)p)	**Max. 1h**	**µg/m³**	**Ground**		**0.013**	**0.009**	**0.010**	**0.011**	**0.010**	**0.010**	**0.011**	**0.011**	**0.009**
			10 m		*0.013*	*0.008*	*0.011*	*0.012*	*0.009*	*0.010*	*0.012*	*0.012*	*0.008*
			20 m	**0.4**	*0.015*	*0.009*	*0.013*	*0.013*	*0.011*	*0.012*	*0.012*	*0.010*	*0.010*
			30 m		*0.023*	*0.010*	*0.012*	*0.013*	*0.010*	*0.011*	*0.013*	*0.011*	*0.009*
			45 m		*0.041*	*0.011*	*0.017*	*0.016*	*0.012*	*0.012*	*0.013*	*0.011*	*0.010*
Formaldehyde	**Max. 1h**	**µg/m³**	**Ground**		**1.36**	**0.99**	**1.07**	**1.13**	**1.07**	**1.03**	**1.18**	**1.10**	**0.94**
			10 m		*1.41*	*0.86*	*1.17*	*1.22*	*0.91*	*1.05*	*1.21*	*1.20*	*0.81*
			20 m	**20**	*1.55*	*0.96*	*1.32*	*1.40*	*1.16*	*1.24*	*1.25*	*1.09*	*1.03*
			30 m		*2.38*	*1.03*	*1.23*	*1.34*	*1.02*	*1.17*	*1.33*	*1.11*	*0.90*
			45 m		*4.30*	*1.17*	*1.75*	*1.71*	*1.21*	*1.28*	*1.34*	*1.10*	*1.07*
1,3-butadiene	**Max. 1h**	**µg/m³**	**Ground**		**0.29**	**0.21**	**0.22**	**0.24**	**0.22**	**0.22**	**0.25**	**0.23**	**0.20**
			10 m		*0.30*	*0.18*	*0.25*	*0.26*	*0.19*	*0.22*	*0.25*	*0.25*	*0.17*
			20 m	**40**	*0.33*	*0.20*	*0.28*	*0.29*	*0.24*	*0.26*	*0.26*	*0.23*	*0.22*
			30 m		*0.50*	*0.22*	*0.26*	*0.28*	*0.21*	*0.25*	*0.28*	*0.23*	*0.19*
			45 m		*0.90*	*0.25*	*0.37*	*0.36*	*0.25*	*0.27*	*0.28*	*0.23*	*0.22*
Ethylbenzene	**Max. 1h**	**µg/m³**	**Ground**		**0.34**	**0.25**	**0.27**	**0.29**	**0.27**	**0.26**	**0.30**	**0.28**	**0.24**
			10 m		*0.36*	*0.22*	*0.30*	*0.31*	*0.23*	*0.27*	*0.31*	*0.30*	*0.20*
			20 m	**8,000**	*0.39*	*0.24*	*0.33*	*0.35*	*0.29*	*0.31*	*0.32*	*0.28*	*0.26*
			30 m		*0.60*	*0.26*	*0.31*	*0.34*	*0.26*	*0.30*	*0.34*	*0.28*	*0.23*
			45 m		*1.09*	*0.30*	*0.44*	*0.43*	*0.31*	*0.32*	*0.34*	*0.28*	*0.27*

(a) Figures in bold were modelled in the original air quality assessment. Figures in italics have been estimated for this report using an emission scaling approach.

The highest ventilation outlet contributions for the existing tall buildings were predicted at a height of 45 metres, and at this height the largest predicted outlet contributions occurred at receptor RWR-11534. These contributions were:

- 0.82 mg/m3 for maximum 1-hour CO, or 3 per cent of the criterion.
- 0.74 µg/m3 for annual mean PM2.5, or 9 per cent of the criterion.
- 6.61 µg/m3 for maximum 24-hour PM2.5, or 13 per cent of the criterion.

The results for annual mean PM2.5 indicate that, for all existing tall buildings the changes in concentration at heights of up to 45 metres above ground level are acceptable (i.e. below the criterion for ΔPM2.5 of 1.8 µg/m3).

For NO2 the ventilation outlet contribution could not be known accurately. For NOX the largest predicted outlet contributions at a height of 45 metres were:

- 13.2 µg/m3 for annual mean NOX
- 381.6 µg/m3 for maximum 1-hour NOX

Assuming a maximum 1-hour background NOX concentration of 589 µg/m3 (as used for RWR receptors at ground level) at this location and height, and therefore a total NOX concentration of 970.6 µg/m3, the resulting NO2/NOX ratio would be 0.21 and the total NO2 concentration would be 205.8 µg/m3. This is still below the criterion of 246 µg/m3. In reality, the background NOX concentration at a height of 45 metres would probably be somewhat lower than at ground level.

With respect to air toxics the largest predicted outlet contributions at a height of 45 metres were as follows:

- Benzene, maximum 1-hour concentration of 3.3 µg/m3, or 11 per cent of the criterion.
- PAHs (as b(a)p) , maximum 1-hour concentration of 0.04 µg/m3, or 10 per cent of the criterion.
- Formaldehyde, maximum 1-hour concentration of 4.3 µg/m3, or 22 per cent of the criterion.
- 1,3-butadiene, maximum 1-hour concentration of 0.9 µg/m3, or 2 per cent of the criterion.
- Ethylbenzene, maximum 1-hour concentration of 1.09 µg/m3, or 0.01 per cent of the criterion.

No data were available to enable background 1-hour concentrations of air toxics to be determined.