NSW GOVERNMENT | Chief Scientist & Engineer

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17 December 2018

Ms Mary Garland
Team Leader – Transport Assessments
Department of Planning and Environment
Level 29, 320 Pitt Street
Sydney NSW 2000

By email: mary.garland@planning.nsw.gov.au

Dear Ms Garland

Comments on the air quality aspects of the EIS of the F6 Extension Stage 1 proposal (SSI 8931)

I refer to your Department's recent letter noting the exhibition of the Environmental Impact Statement (EIS) for the F6 Extension Stage 1 project that was submitted in November 2018.

In the same manner as for the WestConnex M4-M5 Link, the M4 East and the New M5, the Advisory Committee on Tunnel Air Quality is submitting comments on the air quality aspects of the EIS.

Because of the conflicts of interest that several Committee members have in this matter, we have taken the approach, as per previous reviews, of commissioning a review report by the expert non-conflicted member of the Committee, Dr Ian Longley from NIWA in New Zealand, and another suitably qualified independent expert to work with Dr Longley. My office commissioned Mr Åke Sjödin, from IVL Swedish Environmental Research Institute, Gothenburg, Sweden, to work on the report.

I attach the report by Dr Longley and Mr Sjödin.

Should you have any questions, please contact Dr Chris Armstrong, Director, Office of the Chief Scientist & Engineer, on 02 9338 6745 or chris.armstrong@chiefscientist.nsw.gov.au.

Yours sincerely

Professor Hugh Durrant-Whyte
NSW Chief Scientist & Engineer

cc: Keith Ng, keith.ng@planning.nsw.gov.au
Naomi Moss, naomi.moss@planning.nsw.gov.au

17th December 2018

Prof Hugh Durrant-Whyte
NSW Chief Scientist & Engineer
Chair: Advisory Committee on Tunnel Air Quality

Dear Prof Durrant-Whyte

We received from your office a request to review aspects of the F6 Extension – Stage 1 EIS specifically relating to air quality on behalf of the Advisory Committee on Tunnel Air Quality. Please find below our draft review.

Yours sincerely

Dr Ian Longley

Independent Expert: Advisory Committee on Tunnel Air Quality
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Review of the F6 Extension – Stage 1 EIS – Air Quality

Written by Ian Longley and Åke Sjödin on behalf of the Advisory Committee on Tunnel Air Quality

17th December 2018

The review is based on the F6 Extension – Stage 1 Environmental Impact Statement (EIS) published in November 2018. In detail we consider those sections relating to air quality only. This follows our review of sections of the EIS relating to tunnel ventilation only, delivered on 21st September 2018. This review repeats the findings of that review, and expands on them to cover other aspects relating to air quality.

Main findings of the review

Our overall conclusion of the F6 Extension – Stage 1 EIS is that it constitutes a thorough review of high quality. It covers all of the major issues and areas that an EIS for a project of this scale should. The information presented is of suitable detail and logical in order. The choices made regarding data used and methods followed have been logical and reasonable and it is our view that the benefit of exploring alternative approaches would be questionable or marginal.

Specific issues

1. Modelling
    a. General comments on assessment methodology

We find that the assessment methodology is sound and represents best practice. All of the models and data used are appropriate and expertly used. We have found no significant errors nor important omissions.

b. Emission modelling

The methodology used to estimate in-tunnel emissions to assess in-tunnel air quality and also being used as input to the dispersion modelling of exhaust emitted through the tunnel ventilation stacks, is very thoroughly and clearly described in the EIS. Although the method used (PIARC 2012) for deriving emission factors does not explicitly provide those for years beyond 2020, the applied approach provides conservative estimates of the emissions of all substances for the scenario years 2024, 2026 and 2036, thus the in-tunnel emissions are more likely to be overestimated in the EIS rather than underestimated.

The approach to use the most recent knowledge on NO_2/NO_X-ratios, as represented by the last update of the EMEP/EEA Air Pollutant Emission Inventory Guidebook from June 2017, to derive primary NO_2 emissions, is very adequate and fit for purpose for the assessment of in-tunnel air quality, as is the modelling of in-tunnel air concentrations of NO_2 for the worst case scenarios with tunnel traffic average speeds down to 20 km/hr.

Furthermore, we acknowledge the attempt to validate the calculated emissions against measured air pollutant concentrations in the M5 East Tunnel in 2015, as well as deriving input data on heavy vehicle mass for the emission modelling based on measurements of actual heavy vehicle mass with a 1 hour resolution (0-24) on heavy vehicles at the Botany WIM (Weigh-in-motion) station near the M5 East motorway.

The approach applied for emissions modelling for the F6 Extension Stage 1 EIS is exactly the same as for the M4-M5 Link EIS from 2017 and the previous WestConnex EISs (New M5 in 2016 and M4 East in 2015). Thus, the NSW EPA model from 2012 was used to calculate speed- and grade-resolved hot running exhaust emission of six pollutants for nine vehicle types, five road types, and nine model years (from 2003 to 2041), the latter defining the composition of the fleet for each type of vehicle, allowing for technological changes. In the assessment also cold start emissions were taken into account as well as non-exhaust emissions, taken from the most recent version of the EMEP/EEA Air Pollutant Emission Inventory Guidebook from 2016. Since evaporative VOC emissions are not included in the NSW EPA model, these were excluded from the assessment, which is also justified by the fact that running evaporative emissions are considered low and irrelevant for air quality. In addition, the NSW EPA model has been extensively validated (in 2014) in a dedicated tunnel study, in which observed (measured) emission rates were compared with predicted (modelled) emission rates. It was found that the model on average overestimated emissions of each of the pollutants included in the assessment by a factor of 1.7 to 3.3, which indicates that the model outputs generally can be regarded as conservative. The validation study also showed that the model overprediction persisted when emission factors were split into the two vehicle types light-duty and heavy-duty vehicles.

To summarize, the emission modelling approach applied in the F6 Extension Stage 1 assessment can be considered sound and “close-to-state-of-the-art”. Its shortcoming is mainly the lack of update of emission factors in recent years, particularly for newer vehicles (i.e. Euro 6) - both the NSW EPA model and the PIARC model (applied for calculating emissions ventilated from the WestConnex tunnels, and partly also providing emission factor inputs to the NSW EPA model) were launched in 2012. However, this is compensated by the tendency of the model to overestimate emissions as demonstrated for the Sydney vehicle in-use fleet, which is in line with the precautionary principle that should characterize environmental impact statements in general. However, for future EISs it would be desirable that the applied emission model(s) would include also state-of-the-art emission factors for Euro 6, since this will be the predominating emission concept category in only a few years from now.

c. Use and evaluation of meteorological and dispersion models (GRAMM, GRAL)

The EIS has given careful attention to the location of the project close to the coast and its implications for meteorological modelling. Coastal locations are likely to experience higher wind speeds than inland locations and potentially different wind directions due to local land-sea breezes. We find that the approach used to address this using the ‘Match-to-Observations’ function in GRAMM (as recommended in the recent evaluation study of the GRAMM-GRAL package) is highly appropriate in this situation and are comfortable that this is likely to provide the most representative results whilst retaining slight conservatism.

The GRAMM-GRAL dispersion modelling suite has been used appropriately and appears to be giving credible results. The evaluation of the models provided in the EIS (Annexure H) relates to the model’s ability to capture dispersion from open roadways. The model's apparent success in doing this (albeit with some conservatism) may be used to infer that they will perform similarly well in predicting dispersion from a ventilation stack, although this cannot be directly verified due to the non-existence of an observational dataset for the ventilation stacks only.

d. Assessment of background air quality

Assessment of background air quality is a surprisingly challenging aspect of any EIS like this. In common with previous WestConnex and NorthConnex projects considerable funds have been spent on air quality monitoring, putting the F6 Extension in the enviable position of having a far richer observational dataset available than most, if not all, comparable projects.

Despite this, and in common with all previous WestConnex projects, datasets of < 1 year have been under-used or discarded due to monitoring starting too late, despite the fact that these data could be extrapolated to 1 year with acceptable uncertainty.

However, this project benefits from a much larger database of air quality measurements than any previous Sydney tunnel project, as far more data from the WestConnex monitoring sites are now available and have been used in the F6 EIS. Furthermore, sufficient data from the F6 project monitoring is provided in the EIS (Annexure D) to assess the likely implications of not using it directly to assess background concentrations.

We find that these data indicate that background concentrations of relevant air pollutants in the area of the F6 Extension may be at the lower end of the range of concentrations monitored at the stations used in the assessment. This implies that the estimates of short-term and long-term background concentrations are likely to be somewhat conservative – maybe more so than in the WestConnex assessments - but not excessively so.

Although not making full use of the data available, we do not believe that the weakness in background air quality assessment is seriously influencing the key conclusions of the EIS, and in particularly does not impact the health risk assessment.

Therefore, despite these limitations, we find the current assessment of background air quality to be fit for purpose. However, we recommend that careful consideration is given to this issue for the assessment of any future road and road tunnel projects in Sydney.

e. Method to estimate NO_2 concentration

The method used has limitations, which the EIS appropriately acknowledges. However, we find the empirical approach of estimating NO_2 concentrations using observational NO_2 and NO_x data to be sound, appropriate and the approach most suited to the purposes of the EIS.

2. Assessment and management of construction impacts

The methodology applied for the assessment of construction impacts in the F6 Extension Stage 1 EIS is the same as the one applied in the M4-M5 Link EIS from 2017 and the New M5 and M4 East EIS, both from 2015. For assessing the impacts of dust it is based on the guidance (semi-quantitative approach) provided by the UK Institute of Air Quality Management (IAQM) from 2014, but adapted for use in Sydney, taking into account factors such as the assessment criteria for ambient PM_{10} concentrations.

As in the previous EISs, the IAQM procedure is applied to assess the impact of dust release during the four stages of construction:

- Demolition
- Earthworks
- Construction
- Track-out

For each stage the assessment methodology separately considers three different impacts of dust:

- Annoyance due to dust soiling
- Health effects related to an increase in exposure to PM10
- Harm to ecological receptors

The above-ground construction activities, taking place at a number of separate locations within the construction area, have been grouped into two distinct zones. Dust risk assessments have been made for each combination of construction stage/type of dust impact/zone (i.e. in all 24 combinations). The assessment resulted in "High Risk" associated with 14 of these combinations, whereas three were classified as "Medium Risk" and three as "Low Risk". The majority of the "High Risk" combinations (12) occur in the zone with the largest construction footprint. This zone contains a quite high number of receptors (>1200), mainly residential, within less than 20 meters distance from the source area.

Exhaust particle emissions, as well as other noxious pollutants in the exhaust, from on-site plant and site traffic (mainly heavy-duty vehicles transporting dust and dirt from the construction sites onto the public road network), are not included in the impact assessment, since it is claimed that these are not likely to have a significant impact on local air quality, which is stated without any further evidence (see further comment below).

The procedure to assess the impact of odour (mainly related to the release of hydrogen sulfide (H_2S) during the excavation activities on a historical landfill site with contaminated acid sulfate soils) during the construction phase in the F6 Extension Stage 1 EIS appears to be the most ambitious one applied so far compared to earlier EISs. This includes several steps ranging from the selection of quantitative criteria for the assessment of odour from H_2S, through the application of several dispersion models on local meteorological data, and estimation of H_2S emission rates from local sources. The modelling results show that the nearest receptors are exposed to H_2S concentrations well below the odour level. Nevertheless, the EIS recommends onsite odour measurements to be carried out onsite once the construction operations begin, so that site-specific emission rates can be determined and the exposure pattern for the construction re-modelled, alternatively that site odour audits are carried out to determine the actual impacts at the nearest receptors.

As in the previous EISs, the final step in the assessment of construction impacts involves the determination of mitigation measures for the management of impacts, properly described in the EIS. We acknowledge that most of the proposed mitigation measures are "highly recommended", since the majority of the construction phase/type of dust impact combinations were classified as "High Risk" in the assessment. A remark is that one of the mitigation measures highlighted in the EIS is to "minimise *generator and vehicle emissions* during construction of the tunnel", which seems contradictory to what is stated about the impact of exhaust emissions from on-site plant and site traffic to be “unlikely to have a significant impact on air quality” in the assessment chapter. In this case, a clarification from the respondent would be desirable.

To summarize, the approach and ambition of the impact assessment of the construction phase in the F6 Extension Stage 1 EIS is largely the same as in the previous EISs and can be considered sound. In particular the high ambition in the EIS with respect to the approach and methodologies applied to assess the risk for odour exposure due to the release of hydrogen sulfide during the construction activities is acknowledged. For future EISs, it is recommended to consider to substitute, or to complement, the presently applied semi-quantitative approach for the dust impact assessment (IAQM) with the quantitative approach used for odour assessment, since most of the elements for doing this (state-of-the-art dispersion models, qualified modelling and local meteorology) are already in place for the construction impact assessment.

3. Assessment conclusions and equity issues

This project was the first tunnel project in New South Wales for which the SEARS required “a qualitative assessment of the redistribution of ambient air quality impacts compared with existing conditions, due to the predicted changes in traffic volumes”. This was provided at the end of section 8.4.11. The analysis shows that the F6 Extension Stage One is predicted to make only minor and localised changes to the distribution of air quality impacts, and that, in general, ground-level concentrations are predicted to reduce at most locations. We agree with these conclusions, and agree that the analysis provided meets the requirements of the SEARs. The provision of concentration density plots (figures 8-78 to 8-80) is a technical but unbiased way of visualising these conclusions which we support.

4. Health risk assessment

We find the health risk assessment to be sound and agree with those findings directly relating to the ventilation stack emissions. This also true for the health risks associated with drivers’ exposure to elevated NO_2 concentrations when driving through the tunnel, which are below the recommended limit of 0.5 ppm NO_2 also in the worst case scenarios.

5. Detailed comments and errata (Appendix E):

- Page 8-4 and 8-16: Wrong referencing - Annexure C should be referenced to instead of Annexure E.

- Page 8-5: The model used for input data in the F6 Extension Stage 1 EIS is the Sydney Strategic Planning Model (SMPM). In the previous EISs the corresponding model was the WestConnex Road Traffic Model (WRTM). These are most likely the same model, with only the name being changed, but a clarification would be desirable.

- Page 8-11: Footnote references are missing in Table 8-6 on page 8-11:

Table 8-6 Vehicle types in the NSW EPA emissions model

Code	Vehicle type	Vehicles included
CP	Petrol car[(a)]	Petrol car, 4WD[(e)], SUV[(f)] and people-mover, LPG[(g)] car/4WD
CD	Diesel car[(a)]	Diesel car, 4WD, SUV and people-mover
LCV-P	Petrol LCV[(b)]	Petrol light commercial vehicle <3.5 tonnes GVM[(h)]
LCV-D	Diesel LCV	Diesel light commercial vehicle <3.5 tonnes GVM
HDV-P	Petrol HDV[(c)]	Petrol heavy commercial vehicle <3.5 tonnes GVM
RT	Diesel rigid HGV[(d)]	Diesel commercial vehicle 3.5 t < GVM <25 t
AT	Diesel articulated HGV	Diesel commercial vehicle >25 tonnes GVM
BusD	Diesel bus	Diesel bus >3.5 tonnes GVM
MC	Motorcycle	Powered two-wheel vehicle

Notes:

(a) Referred to as 'passenger vehicle' in the inventory

(b) LCV = light commercial vehicle

(e) 4WD = four-wheel drive

(f) SUV = sports-utility vehicle

(g) LPG = liquefied petroleum gas

- Page 8-14 – 8-15: Underlying percent emission changes presented in the text on page 8-14 do not agree with corresponding changes in Table 8-10 on page 8-15:

The overall changes in emissions associated with the project in a given future scenario year (2026 or 2036) would be smaller than the underlying reductions in emissions from the traffic on the network between 2015 and the scenario year as a result of improvements in emission-control technology. Although there are some differences between the definitions of the Base Year and Do Minimum scenarios, it can be seen from **Table 8-10** that between 2016 and 2026 the total emissions of CO, NO_X and THC from the traffic on the road network are predicted to decrease by 50 per cent to 60 per cent, depending on the pollutant. Between 2016 and 2036 the reductions are between 55 per cent and 70 per cent. For PM_{10} and $PM_{2.5}$, the underlying reductions are smaller: around 20 per cent for PM_{10} and 30 per cent for $PM_{2.5}$. This is because there is currently no anticipated regulation of non-exhaust particles, which form a substantial fraction of the total. In the case of PM_{10}, the underlying reductions in emissions are similar to the increases associated with the project, whereas for $PM_{2.5}$ the underlying reductions are larger than the increases due to the project.

Table 8-10 Percentage changes in total traffic emissions in the GRAL domain

Scenario comparison	Change in total emissions (%)				
	CO	NOx	PM_{10}	$PM_{2.5}$	THC
Underlying changes in emissions with time[(a)]					
2026-DM vs 2016-BY	-41.6%	-34.4%	1.8%	-7.8%	-48.2%
2036-DM vs 2016-BY	-55.9%	-38.9%	6.1%	-6.3%	-61.2%
Changes due to the project in a given year					
2026-DS vs 2026-DM	-2.2%	-3.4%	-2.9%	-3.0%	-1.8%
2036-DS vs 2036-DM	2.2%	1.1%	1.3%	1.4%	-0.3%
2036-DSC vs 2036-DM	3.9%	2.5%	2.7%	2.9%	-2.0%

- Page 8-16: Instead of acronym LCT, write out Lane Cove Tunnel.