NSW EPA

Our reference: DOC14/130178
Contact: Peter Morrall

Dominic Crinnion
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Dear Mr Crinnion,

EPA response to public exhibition – M1-M2 NorthConnex EIS (SI 6136)

I refer to your letter dated 14 July 2014 inviting the NSW Environment Protection Authority (EPA) to make a submission regarding the Environmental Impact Statement (EIS) for major civil construction works on the NorthConnex project.

The EPA has reviewed the EIS and provided comments and recommendations in relation to the conditions of approval for the key issues of air quality, noise and vibration, surface water and groundwater (see attached).

The EPA would appreciate a copy of the submissions received by the Department of Planning and Environment (DP&E) in relation to the exhibition of the EIS. The EPA also requests the opportunity to comment on the draft conditions of approval proposed by DP&E and recommend additional conditions of approval if required based on the proponent's response to submissions.

If you wish to discuss any of the issues raised in this letter please contact Peter Morrall, Senior Operations Officer, EPA on 9995 6810.

Yours sincerely

12-9-14

FRANK GAROFALOW
Manager Infrastructure
Environment Protection Authority

Encl: EPA's submission on the Environmental Impact Statement for the M1-M2 NorthConnex project.

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EPA's submission on the Environmental Impact Statement for the M1-M2 NorthConnex project.

ENVIRONMENT PROTECTION LICENCING

In accordance with Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act), this project will require an environment protection licence (EPL) for construction. The proponent will need to make a separate application to the EPA for this licence if project approval is granted.

The EPA has met with the preferred tenderer (Lend Lease Bouygues Joint Venture) and the proponent to discuss the EPL and to outline the EPA's expectations regarding a Community Relations Strategy, requirements for out of hours works and early formation and convening of an Agency and Local Council Environment Review Group (ERG).

WATER QUALITY

Water discharges to stormwater and local waterways.

The EIS does not state the relevant Water Quality Objectives and environmental values for the receiving waters of the project or any indicators and associated trigger values for these environmental values.

The DGRs include a requirement that "The assessment of water quality impacts is to have reference to relevant public health and environmental water quality criteria, including those specified in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000), and any applicable regional, local or site-specific guidelines". It should also be noted that following section 45(f1) of the POEO Act, EPA is required to take the environmental values of receiving waters into consideration in its licensing decisions.

The EPA recommends that assessment be given to the following:

- *Statement of the ambient Water Quality Objectives (WQOs) and the environmental values for the receiving waters relevant to the proposal. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters (http://www.environment.nsw.gov.au/ieo/index.htm).*
- *Statement of the indicators and associated trigger values or criteria for the identified environmental values.*

The EIS has not provided any predicted water quality discharge concentrations during the construction and operational phases.

The EPA recommends that assessment be given to the following:

- *Identification and estimation of the quality and quantity of all pollutants that may be introduced into the water cycle by source and discharge point, including residual discharges after mitigation measures are implemented. This should be undertaken for construction and operational phases;*
- *Assessment of the significance of any identified impacts including consideration of the relevant ambient water quality outcomes. Demonstration of how the proposal will be designed and operated to:*
    - *protect the WQOs for receiving waters where they are currently being achieved; and*
    - *contribute towards achievement of the WQOs over time where they are not currently being achieved.*

Water discharges during construction phase:
The EIS states that it is anticipated that the discharge water quality requirements for the construction phase would be consistent with the 80 per cent protection level for freshwater ecosystems in accordance to the ANZECC Guidelines. The EPA does not consider the 80 per cent protection level appropriate for this project.

While it is understood that the proposed works are near highly disturbed waterways, the ANZECC Guidelines recommend that "*guideline trigger values for slightly–moderately disturbed systems also be applied to highly disturbed ecosystems wherever possible*". The Guidelines state that: "*the aim is to eventually restore highly disturbed systems to a slightly to moderately disturbed condition*", and that: "*It is not acceptable to allow poor environmental performance or water pollution, simply because a waterway is degraded*". Additionally, many of the receiving waters drain to sensitive receiving environments (e.g. Ku-ring-gai Chase National Park, Lane Cove National Park and Bidjigal Reserve) through ephemeral streams where there is the potential for little or no dilution to occur before reaching the sensitive receiving environments. Furthermore, the EPA considers the construction phase of nearly 4 years a significant duration and does not consider the temporary nature of the construction works a valid reason to lower the protection level.

The EPA recommends that, as a minimum, the 95 per cent protection level is considered during the construction phase.

During the construction phase, it is proposed that four water treatment plants will treat construction water, surface water runoff that drains into the tunnels and groundwater inflow and then discharge into receiving waters (stormwater and local waterways). The EIS has identified that the water treatment would typically involve: flocculation to remove total suspended solids, reverse osmosis to reduce salinity and dissolved solids; and correction of pH level.

The EPA considers it appropriate that assessment is undertaken on the potential, and a requirement to treat, hydrocarbons during the construction phase.

Water discharges during operational phase
The typical water treatment methods proposed for the operational phase generally appear acceptable; however, consideration of the potential impacts of the use of a biocide in the water treatment plant is needed as additional treatment may be required.

The EPA recommends that assessment be given to the potential impact of the proposed biocide usage on the receiving environment associated with the operational phase water treatment plant.

Environmental Management Measures
The EIS provides no detailed information about the environmental management measures relating to surface water and groundwater for the construction and operational phases of the project.

The EPA recommends the conditions of any consent include the following:

Prior to works commencing the Proponent must obtain the EPA's approval for a comprehensive Surface Water Management Plan (SWMP) to be developed in consultation with the EPA. The SWMP must include but not be limited to:

- *a) address construction and operation monitoring, management and response arrangements*
- *b) specifications and design details of the Water Treatment Plants*
- *c) identification and estimation of the quality and quantity of all pollutants that may be introduced into the water cycle by source and discharge point for the construction and operation phases*
- *d) an assessment of the potential impact of discharges on receiving surface waters and human health*
- *e) a Surface Water Quality Monitoring Program (SWQMP)*
- *f) a Soil and Water Management Plan (SWMP) to cover soil erosion and sediment control measures for any areas that may be disturbed*

The assessment of the potential impact of discharges on receiving waters must include but not be limited to:

a) *detailed assessment of baseline data on current water quality in any receiving waters that could be affected by the project*
b) *a statement of the ambient Water Quality Objectives (WQOs) and the environmental values for the receiving waters relevant to the proposal*
c) *a statement of the indicators and associated trigger values or criteria for the identified environmental values*
d) *assessment of the significance of any identified impacts on surface waters including consideration of the relevant ambient water quality outcomes. Demonstration of how the proposal will be designed and operated to:*
    a. *protect the WQOs for receiving waters where they are currently being achieved; and*
    b. *contribute towards achievement of the WQOs over time where they are not currently being achieved.*
e) *use of the appropriate level of protection for each contaminant (for example, contaminants that bio-accumulate should have a 99% protection level).*

The SWQMP must be prepared by a suitably qualified and experienced person and include but not be limited to:

a) *a statement of the ambient Water Quality Objectives and environmental values for the receiving waters relevant to the proposal*
b) *a statement of the indicators and associated trigger values or criteria for the identified environmental values*
c) *trigger values for action and associated actions or mitigation measures if trigger values are exceeded*
d) *a water quality monitoring program with relevant analytes and with a sampling distribution and frequency appropriate to the nature and extent of potential pollution and activities being conducted onsite*
e) *location of discharge points and monitoring locations.*

The SWMP must be prepared by a suitably qualified and experienced person and include but not be limited to:

a) *soil erosion and sediment control measures that comply with the practices and principles contained in Managing Urban Stormwater – Soils and Construction, Volume 1 (the Blue Book)*
b) *design calculations and sizing for all clean water diversion bunds and sediment basin(s) on site*
c) *plan drawings showing the locations for soil erosion and sediment control practices for the site*
d) *written text detailing the installation, monitoring and maintenance requirements for all of the soil erosion and sediment control practices*
e) *drawings of any engineering structures such as sediment basin(s) and clean water diversion structures, including design standards and management regimes to return the system to design capacity following rainfall events.*

AIR QUALITY

The EPA has reviewed the Air Quality Impact Assessment (AQIA) completed for the NorthConnex project. The review has focussed on those aspects of the assessment that could materially affect ambient air quality at local sensitive receptors.

There are certain inputs to the air quality assessment, for example traffic modelling, where the EPA is an end user of this data and does not have relevant technical expertise to provide a meaningful review. For the purposes of the air quality assessment review, the EPA has assumed the traffic modelling completed for the project and adopted in the air quality assessment is accurate.

The AQIA has generally been conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.*

AECOM (2014) predicts the NorthConnex project will not result in any additional exceedences of the EPA's impact assessment criteria at the surrounding sensitive receptors for the operating scenarios assessed. This includes the worst case scenario of theoretical maximum design capacity during peak hour (4000 passenger car units per hour in each main tunnel).

Notwithstanding the predicted compliance with the EPA's assessment criteria, the EPA has identified several issues with the air quality impact assessment that are detailed in Attachment 1 and Attachment 2.

Attachment 1 includes issues associated with the dispersion modelling conducted for the project, including:

1. Background NO_2 concentration data may not be conservative for all hours;
2. No details regarding key meteorological modelling options;
3. Lack of sufficient evaluation of CALMET generated wind speed and direction data;
4. Potential underestimate of NO_2 ground level concentrations; and
5. Significant contribution of project to impact assessment criteria at sensitive receptors.

Attachment 2 includes an analysis of vehicle emission estimation techniques, including:

1. No details regarding assumed fleet composition;
2. Insufficient information on how non exhaust PM_{10} emissions were calculated; and
3. Lack of clarity regarding how NO_2 emissions were estimated.

Whilst the project is predicted to comply with the EPA's impact assessment criteria, it is predicted to significantly contribute to the impact assessment criteria at some sensitive receptors. For the worst case scenario of theoretical maximum design capacity, the project is predicted to contribute up to 47% of the 1 hour average NO_2 impact assessment criteria. The EPA therefore considers the proponent should:

1. Evaluate the practicability of options for reducing predicted ground level concentrations; and
2. Resolve the issues raised in Attachment 1 and Attachment 2 to demonstrate the assessment shortcomings do not significantly change the results of the impact assessment.

To facilitate transparent and robust planning decisions, the EPA recommends the proponent provide the additional information outlined in Attachment 1 and Attachment 2.

Off Road Diesel Emissions

The environmental impacts associated with off road diesel equipment can be a major source of fine particles. The EPA recommends that the proponent assess the environmental impacts associated with heavy vehicles including off road diesel equipment and plant used in the construction of the project. This should include but is not limited to:

- Compliance with relevant and current emission standards as prescribed in Australian design Rules for heavy duty engines and vehicles.
- Strategies for minimising air emissions from off road diesel equipment including but not limited to graders, bulldozers, loaders etc.
- Confirmation that all off road diesel equipment will meet best available diesel emissions standards or be fitted with an appropriate diesel exhaust treatment device where possible.

NOISE and VIBRATION

The EPA previously reviewed the draft EIS dated 9 May 2014 and its Working Paper dated 12 May 2014 and advised the Department of Planning and Environment that further information was required on a number of issues relating to noise. A number of the issues previously identified by the EPA have not been adequately addressed in the EIS.

Construction Noise and Vibration

Works are proposed outside the standard construction hours stated in the *Interim Construction Noise Guideline* (ICNG), often without sufficient clarity as to their duration, location and extent. For example, the Working Paper states that rock hammering in the tunnel will be avoided between 10pm and 7am, but does not explain why this activity cannot be instead undertaken during standard hours only. Similarly, M2 integration works, bridge works and 'surface works supporting construction' are proposed on a 24 hour/7 day basis without adequate justification for the potential impact or evidence of community consultation and support.

The EPA considers that works should be restricted to the standard construction hours in the ICNG unless clear justification is provided.

Ground-borne noise from tunnelling is predicted to impact sensitive receivers at an internal level up to 45 dBA, 24 hours a day for up to two days, with ground-borne noise discernible at each receiver for up to five days (Working Paper page 63). No mitigation measures are proposed for these receivers.

The EPA recommends that a strategy for dealing with regenerated noise impacts from tunnelling works is developed.

The construction traffic noise assessment in section 7.2.4 of the EIS states that during the quietest periods of the night, construction traffic will increase local road noise by more than 2 dBA, but is mitigated by the dominant noise effect of major roads (page 422).

The EPA recommends that the expected worst-case construction traffic noise should be compared to measured overall road traffic noise levels to demonstrate this.

The cumulative construction noise assessment indicates that the reasonable worst case scenario for construction of this project alone may be 3 dBA or more above the predicted levels for each component in isolation (section 7.2.4 EIS page 425 and Working Paper page 79).

The EPA recommends that mitigation measures for construction impacts should be chosen based on the reasonable worst case scenario for all components of this project and further detail provided on these mitigation measures and their effectiveness in reducing cumulative noise levels.

The Working Paper states that "L_{A1} sound power levels are typically up to eight dBA above L_{Aeq} sound power levels" (page 47). However some plant, for example excavators with rock hammers and piling rigs, may have a greater differential and the assumed 8 dBA.

The EPA recommends that the differential should be justified by reference to appropriate literature or measurement values.

The sleep disturbance impacts of construction traffic do not appear to have been assessed in accordance with guidance in the NSW Road Noise Policy and RMS Environmental Noise Management Manual.

The EPA recommends that a strategy for dealing with construction traffic noise impacts, including sleep disturbance, is provided that will cater for the various routes that construction traffic will use throughout the project.

With respect to mitigation, a Construction Noise and Vibration Management Plan (CNVMP) is proposed and a number of general methods to address construction noise impacts mentioned, but no specific measures have been assessed or committed to, nor has any assessment of their mitigation performance at sensitive receivers been carried out. Similarly with regard to construction vibration mitigation, a number of general measures are discussed, but no specific measures or their respective performance have been assessed or committed to.

The modelling assumptions are generally reasonable:

- No temporary barriers have been assumed, which is a conservative assumption.
- All equipment has been considered to be operating concurrently, which is a conservative assumption.
- Acoustic sheds are proposed, with an insertion loss of '25'. Clarification should be provided that this is 25 dB.
- Equipment is considered to be operating at the closest location to receivers, which is a conservative assumption.

Underground equipment is not modelled, which is reasonable, except when operating at or near portals/openings.

The EPA recommends that clarification should be provided on how the impacts of underground equipment have been accounted for in the modelling.

Operational Noise

The EIS states that Stone Mastic Asphalt is proposed for the motorway ramps, in accordance with the tender design.

The EPA recommends that consideration be given to the use of Open Graded Asphalt (OGA) to compare the additional noise benefit against the maintenance requirements.

A ground absorption factor of 0.75 has been used, and is supported by calibration results. However, a lower figure may be more appropriate in an urban/suburban situation such as this. The near-field calibration point results would not be a reliable indicator of the appropriateness of a particular absorption factor. The EPA considers that using a more conservative lower absorption factor would lead to higher predicted levels at distances from the road.

The EPA recommends assessment using a more conservative lower absorption factor.

The scope for defining the study area is different to the 600m envelope method used in the NSW Road Noise Policy.

The EPA recommends that, while there has previously been discussions with RMS regarding the differences between these two methods, the assessment should explicitly state that applying the 'highly urban' area approach will not result in diminished mitigation outcomes or increased noise impacts to the surrounding community.

The modelling of traffic noise from tunnel portals has been carried out using a commercial software package using a recognised calculation method (SoundPLAN Nord2000). However more detail on the values chosen for the input variables to the model, and its accuracy, is warranted in the assessment.

The EPA recommends that clarification be provided regarding the input values to the model and its accuracy.

Noise mitigation measures are proposed for a number of receivers, however no clear commitment to provision of mitigation measures has been made in the assessment.

The EPA recommends that the proponent provides detailed noise mitigation measures for affected receivers and a commitment to the provision of those measures.

ATTACHMENT 1 – Review of Dispersion Modelling

1. Background NO_2 concentrations are not demonstrated as conservative for all hours assessed.

AECOM (2014) claim a conservative approach to $PM_{2.5}$, PM_{10} and NO_2 background concentrations was adopted in the assessment. The assessment assumes the maximum of the concentrations predicted by CAL3QHCR (surface road model) and those measured by OEH at its Lindfield and Prospect monitoring stations as the background concentration for each receiver for each hour of each modelling year.

The results of an analysis of the following datasets are used to support the claim that the assumed background concentrations are conservative:

- Project road side monitoring data (Brickpit Park and Observatory Park) collected between December 2013 and March 2014 and predicted surface road modelling concentrations (using CAL3QHCR) at Brickpit Park and Observatory Park.
- Ambient monitoring data collected at OEH's Prospect and Lindfield monitoring stations and ambient (background) project monitoring data (Headen Sports Park, James Park and Rainbow Farm Reserve) collected between December 2013 and March 2014.

The results of the statistical analysis are presented in Appendix C of AECOM (2014) and demonstrate the following:

- OEH PM_{10} monitoring data is higher than the project PM_{10} ambient monitoring data for the majority of the time;
- Project NO_2 monitoring data is higher than the OEH NO_2 ambient monitoring data for the majority of the time;
- CAL3QHCR road modelling predictions (PM_{10} and NO_2) are greater than the project road side monitoring data for the majority of the time.

Appendix C confirms the CAL3QHCR road modelling predictions and OEH PM_{10} and $PM_{2.5}$ monitoring data are conservative datasets and their use in the assessment will result in conservative background concentrations.

The OEH NO_2 monitoring data, however, is not demonstrated to be conservative as the statistical analysis demonstrates the project NO_2 monitoring data is typically higher than the OEH NO_2 monitoring data. Appendix C acknowledges this result but states that as the average percentage difference between the two datasets was only 0.7 percent then the OEH data was considered satisfactory for use as background concentrations without any adjustment of the data.

The EPA considers that the proponent should have adjusted the assumed NO_2 background concentrations to be able to claim that a conservative approach to background concentrations was adopted. The EPA recommends the proponent uses conservative background NO_2 data in the assessment.

2. Modelled meteorological data input parameters are not presented for verification

The CALPUFF modelling system was used in the air quality impact assessment and consists of three main components:

- CALMET: a meteorological model which develops hourly wind and temperature fields on a three-dimensional gridded domain;
- CALPUFF: a transport and dispersion model, which advects puffs of material emitted from the modelled source simulating dispersion and transformation along the way using the fields generated by CALMET; and

- CALPOST: processes the primary output files from CALPUFF of hourly concentrations or deposition fluxes at selected receiver locations.

The dispersion modelling was undertaken for a three year period (January 2009 – December 2011). The following meteorological data were used as inputs to CALMET:

- Gridded hourly three dimensional MM5 data resolved at a 12 kilometre resolution to generate the 'initial guess' wind field in CALMET; and
- Hourly observations from Lindfield, Terrey Hills, Richmond RAAF Base, Prospect and Sydney Airport to generate the final three dimensional wind fields for use in CALPUFF.

This methodology for incorporating the meteorological data in CALMET is referred to as the 'Hybrid Mode' in OEH (2011)[1] and is a refined model run. The meteorological data has been incorporated in CALMET as recommended in OEH (2011).

Using CALMET with observational data, as in the Hybrid Mode, requires the careful site specific assessment of seven critical parameters. These are: TERRAD, RMAX1, RMAX2, R1, R2, IEXTRP and BIAS. AECOM (2014) does not present the assumed value of these seven critical parameters.

The EPA recommends the proponent provides and justifies the values assumed for these seven critical parameters.

3. Modelled meteorological data is not evaluated

It is important to undertake an evaluation of the CALMET modelling results as the CALMET module requires careful consideration of input data, modelling domain, grid resolution and the seven critical parameters. AECOM (2014) presents a number of meteorological data evaluation studies:

- Comparison of year 2009 - 2011 Sydney Airport Bureau of Meteorology (BoM) data with longer term (30 year) statistics to establish the suitability of these years for the modelling assessment.
    - AECOM (2014) demonstrates year 2009, 2010 and 2011 meteorological data are suitable for use in the assessment as they are consistent with the longer term averages recorded at the site. As OEH meteorological data was also used in the assessment, the five year statistics for Prospect station were compared to the data for 2009, 2010 and 2011. This analysis showed the data from the years used in the modelling are very similar to the five year averages and confirmed their suitability for use in the assessment.

- Statistical evaluation of MM5 data, used to generate an initial guess field in CALMET, versus observations for 2009, 2010 and 2011. The MM5 data was generally demonstrated to meet the relevant statistical benchmarks. The analyses showed a tendency for MM5 to over predict wind speed and some randomness in the wind direction data. This was expected given the 12 kilometre grid resolution.

- Analysis of CALMET generated stability class data at Prospect and Sydney by hour of day and wind speed. This analysis generates the expected variation in stability class with hour of day and wind speed.

- Presentation of CALMET generated windroses for the northern and southern ventilation outlets and windroses for each of the five observation stations for year 2009, 2010 and 2011. AECOM (2014) does not provide an analysis of the CALMET generated windroses for the northern and southern

[1] OEH (2011) Generic guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, Australia' March 2011, Prepared for NSW Office of Environment and Heritage, Prepared by Jennifer Barclay and Joe Scire, TRC Environmental Corporation.

ventilation outlets or a discussion regarding the suitability of the CALMET generated wind speed and wind direction data in CALPUFF.

The EPA considers AECOM (2014) does not demonstrate the suitability of the CALMET generated wind speed and wind direction data. The EPA acknowledges the issues regarding evaluation of CALMET generated meteorological data when observations are used to generate the data. There are, however, other wind speed and direction data available in the modelled domain that were not used to generate the modelled meteorological data and could be used to evaluate the suitability of the CALMET data.

The EPA recommends the proponent provides an evaluation of the CALMET generated wind speed and wind direction data to demonstrate it is suitable for use in CALPUFF.

4. NO_2 modelling may have under predicted potential project increments

Oxides of nitrogen (NO_X) are formed during high temperature combustion processes from the oxidation of the nitrogen in the air or fuel. NO_X from combustion consist largely of nitric oxide (NO) and partly of nitrogen dioxide (NO_2). After emission from the stack, NO is transformed to NO_2 through oxidation with atmospheric ozone.

AECOM (2014) has applied the USEPA's ozone limiting method (OLM) to assess the oxidation of NO to NO_2 in the atmosphere. OLM is listed in the *Approved Methods for the Modelling and Assessment of Air Pollutants* as a method for assessing the oxidation of NO to NO_2:

$$NO_{2\ \text{project increment}} = 0.1x\ [NO_X]_{\text{prediction}} + \text{MIN}\ \{(0.9)x\ [NO_X]_{\text{prediction}}\ \text{or}\ (46/48)\ x\ [O_3]_{\text{background}}\} \quad (1)$$

By default, OLM assumes that approximately 10% of the initial NO_X emissions are emitted as NO_2 and that all of the available ozone in the atmosphere will react with NO in the plume until either all the ozone or all the NO is used up.

As discussed in **Attachment 2** (Section 3), the EPA estimates the total fleet average NO_2 fraction ranges between 15% and 17% across the speed range. An average of 16% (not 10%) of the initial NO_X emissions from the ventilation outlets could therefore be emitted as NO_2.

The OLM equation should be adjusted to account for the site specific in stack ratio of NO_2/NO_X. That is, the 0.1 in the above equation should be replaced with 0.16:

$$NO_{2\ \text{project increment}} = \mathbf{0.16}x\ [NO_X]_{\text{prediction}} + \text{MIN}\ \{(0.9)x\ [NO_X]_{\text{prediction}}\ \text{or}\ (46/48)\ x\ [O_3]_{\text{background}}\} \quad (2)$$

The effect of the adjustment is to increase the amount of NO_2 directly emitted at the point of release (stack discharge) by 60%, potentially increasing ground level concentration predictions under lower ambient ozone (O_3) conditions. The assessment does not include sufficient information and data, such as all hourly NO_X predictions and all hourly O_3 values to comprehensively audit the effect of the methodological shortcoming on the overall project results.

The EPA has undertaken some preliminary calculations to determine the impact on the results of the impact assessment. The EPA increased the entirety of the predicted project increment by 60% and the results are displayed in the table below (Table 1). It can be seen that all scenarios except the worst case Design Analysis A is predicted to still comply with the EPA's impact assessment criteria. The EPA anticipates the proper implementation of equation (2) is likely to result in all scenarios still complying with the EPA's impact assessment criteria, however this should be verified and confirmed by the proponent.

Table 1 Sensitivity analysis of NO_2 impact assessment results

Scenario	Peak Project Contribution (µg/m^3)	60% increase in Peak Project Contribution (µg/m^3)	Background Concentration (µg/m^3)	Peak Cumulative Concentration (µg/m^3)[3]
2a[1]	68.9	110.2	81.9	192.1
2b[1]	74.6	119.4	84.7	204.1
Design Analysis A	114.8	183.7	67.2	**250.9**
Design Analysis B[1,2]	96.4	154.2	84.7	238.9

1. North Ventilation Outlet
2. Expected traffic flow, 2029,
3. 1 hour average NO_2 impact assessment criteria is 246 µg/m^3

The EPA recommends the proponent revises the NO_2 impact assessment to use a site specific NO_2/NO_X ratio that represents the expected NO_2/NO_X ratio of the vehicle fleet based on a detailed analysis of fleet composition and fuel type to confirm all scenarios are still predicted to comply with the EPA's NO_2 impact assessment criteria.

5. Project contribution to ground level concentrations and options for improved environmental performance

AECOM (2014) predicts the NorthConnex project will comply with the EPA's impact assessment criteria at all sensitive receptors. Whilst compliance with the criteria is the EPA's benchmark for assessing the project, it is also prudent to review the project contribution to predicted ground level concentrations. A summary of the highest predicted contributions for the project is provided in the table below (Table 2).

Table 2 Maximum predicted project contributions to assessment criteria

Pollutant	Averaging Period	Scenario 2b (%)	Design Analysis A (%)
PM_{10}	24 hour	4.2 [1]	6 [1]
	Annual	0.4 [1]	0.9 [1]
$PM_{2.5}$	24 hour	**8.0** [1]	**12** [1]
	Annual	1.6[1]	3[1]
NO_2	1 hour	**30**[2]	**47**[2]
	Annual	3 [2]	4 [2]
CO	1 hour	0.36 [2]	0.6[2]
	8 hour	0.58[1]	0.8[1]
Total VOCs	1 hour	19 [2]	31 [1]
PAHs	1 hour	0.23[1]	0.4 [1]

1. Southern ventilation outlet
2. Northern ventilation outlet

It can be seen in the above table that the project is predicted to result in significant contributions to the 1 hour average NO_2 impact assessment criteria, 30% for Scenario 2b and 47% for Design Analysis A. The project is also predicted to contribute up to 8% of the 24 hour average $PM_{2.5}$ criteria for Scenario 2b and 12% for Design Analysis A.

Given the project is predicted to significantly contribute to the overall ground level concentrations at some sensitive receptors, the proponent should consider options for reducing predicted impacts.

Predicted ground level concentrations due to emissions from the NorthConnex stacks could be reduced by improving the dispersion of emissions. Typical options for improving the dispersion of stack emissions include increasing stack height, decreasing stack diameter and/or increasing stack exit velocity. Each one of these would need to be evaluated for its practicability.

A reduction in the concentration of emissions from the stacks would also reduce predicted ground level concentrations. This could be achieved by increasing ventilation flow rate to further dilute the vehicle emissions, prior to discharging through the stacks or increasing the number of stack used to discharge emissions.

The EPA recommends the proponent evaluates the practicability of options for reducing predicted ground level concentrations, as the project is predicted to significantly contribute to the predicted ground level concentrations of NO_2 and particles at sensitive receptors.

ATTACHMENT 2 – Review of Vehicle Emissions Estimation Techniques

The methodology used to estimate motor vehicle emissions in the NorthConnex EIS has been reviewed. The estimation of motor vehicle emissions provides the fundamental input to the ambient air quality impact assessment and hence it is crucial that the modelling of the vehicle emissions is robust.

Accurate estimation of the emissions from the vehicle fleet relies on three key elements:

1. Estimation of the fleet composition and traffic mix. Emissions vary significantly dependent on vehicle type and mass, fuel type, and age and technology of vehicle and hence the fleet composition has a significant impact on the total emissions estimated.
2. Development of appropriate emission factors to assign to the vehicle fleet defined in point 1.
3. Traffic modelling to define operating conditions such as average speed, congestion etc.

The EPA has reviewed vehicle emission estimation in relation to the first two points above. The EPA does not have sufficient expertise to provide comment on the traffic modelling in any detail. With respect to the impact of vehicle speeds and operating conditions as they impact vehicle emissions, the predicted level of service (LOS) in the tunnel are provided in Table 8-10 of Appendix E and the travel times and implicit average speed in Table 8-12 of Appendix E. For the purposes of this review, the EPA has assumed these factors provided by the proponent are correct.

The overarching comment regarding the estimation of motor vehicle emissions is that the EIS does not provide a clear explicit description of how the emission were estimated. There is conflicting and confusing information spread widely throughout the document, which is poorly structured in terms of being able to find the relevant information or definitively understand how the emissions have been calculated.

1. Fleet Composition and Traffic Mix

- No clear complete presentation is given in the EIS of the fleet composition assumed in the vehicle emission modelling. The project traffic modelling presented separates the fleet into light vehicle and heavy vehicles only (eg. Table 7-26).

- The EIS assumes a constant 8% of passenger vehicles are diesel powered (Appendix H of Appendix G) sourced from the 2013 Australian Bureau of Statistics (ABS) Motor Vehicle Census (MVC) for the entire Australian fleet. The EIS states that the ABS MVC shows a strong growth in the proportion of diesel passenger vehicles from 2008 to 2013, however then states that the 2013 diesel passenger vehicle proportion of 8% was used for the assessment in 2019 and 2029. This is considered a significant assessment weakness as sales data show a strong increase in the sales share of diesel passenger vehicles and diesel light commercial vehicles and diesel vehicles have significantly higher NO_x, NO_2 and particle emissions than equivalent petrol vehicles. EPA projections developed for the NSW Air Emissions Inventory estimate diesel passenger vehicles will comprise 17% of the passenger vehicle fleet in 2019 and 27% in 2029.

- No information is presented in the EIS on the proportion of light commercial vehicles in the light vehicle traffic that was used in the modelling. In the absence of explicit information, it can only be assumed that the NorthConnex modelling used the PIARC Australian assumption of 84% passenger vehicles and 16% light duty vehicles (light commercial vehicles (LCV)). The default PIARC figure appears reasonable in comparison to EPA inventory models which estimate 18-20% LCV dependent on road type and day of week.

- No information is presented in the EIS on the proportion of diesel vehicles in the light commercial vehicle feet that was used in the modelling. In the absence of explicit information, it can only be

assumed that the NorthConnex modelling used the PIARC Australian default of 50%. New vehicles sales data indicates that similar to passenger vehicles, the sales share of diesel LCV is increasing strongly. The PIARC estimate of 50% is reasonable for 2019 but is likely to underestimate diesel LCV in 2029 relative to the EPA inventory models which estimates 63% of LCV will be diesel powered. Diesel powered LCV have considerably higher NO_x, NO_2 and particle emission rates than equivalent petrol LCV.

- No information is presented in the EIS on the heavy duty vehicle fleet composition used in the modelling. The heavy duty fleet will comprise rigid trucks (no trailers) 3.5 to ~ 26 tonnes, articulated (semi-trailer) and heavy truck trailer combinations of approximately 25 to 42 tonnes, and long multi-trailer combinations (B-doubles) of 40-60 tonnes. In absence of explicit information, it can only be assumed that the NorthConnex modelling used the PIARC Australian default of 83% "single lorry" at 15 tonnes, and 17% "truck-trailer combinations/semitrailers" at 32 tonnes average, giving a combined average of 17.9 tonnes. This compares reasonably well with RMS weigh-in-motion (WIM) data across all Sydney WIM sites for 2013 which gives an average of 16.6 tonnes.

The EPA recommends the proponent provides the detailed fleet composition assumed in the assessment. The assumed fleet composition should be provided by vehicle type and fuel type. Where the assumed fleet adopted in the current assessment cannot be adequately justified, a revised emissions inventory should be provided and, if necessary, a revised air quality impact assessment undertaken.

2. Vehicle Emission Factors

PM Emission Factors and PM_{10}-$PM_{2.5}$ Determination

- It is not stated in the EIS how non-exhaust PM_{10} emissions are calculated from the PIARC $PM_{2.5}$ non-exhaust emissions. The European EMEP/EEA emission inventory guidebook 2009 covering non-exhaust PM emissions indicates that PM_{10} emissions from these sources are around 70-80% higher than $PM_{2.5}$ emissions. The NSW EPA 2008 Air Emissions Inventory estimates that non-exhaust PM_{10} emissions are nearly double non-exhaust $PM_{2.5}$, and in 2011, the non-exhaust PM_{10} for the total fleet is 50% higher than the exhaust source PM_{10}.

The EPA recommends the proponent clarify how non-exhaust PM_{10} emissions were calculated given PIARC only provides $PM_{2.5}$ non-exhaust emissions. If emissions were underestimated, the proponent should provide a revised air quality impact assessment to account for any changes to the estimate of non-exhaust PM_{10} emissions.

NO_2 Emissions

- The EIS does not appear to discuss how NO_2 emissions were calculated. The only reference is a footnote to various tables such as tables 18 and 19 of Appendix G, where it is stated that "NO_2 has been assumed to be 10 per cent of total nitrogen oxides, consistent with PIARC (2012). This implies that this ratio was applied to all vehicle types.

- Light duty diesel vehicles have significantly higher NO_2 emissions as a proportion of total NO_x. The EPA inventory uses information from the European EMEP/EEA emission inventory guidebook 2009 which gives Euro certification specific NO_2 fractions, which for light duty diesels range up to 55% for

Euro 4-6. Using this data the EPA NSW inventory estimates in 2021 the NO_2 fraction for diesel light duty vehicles is around 54%.

- The NO_2 fraction of petrol light duty vehicles in the EPA inventory is estimated to be 3% while for heavy duty diesel vehicles a fraction of 11-12% is estimated.

- The EIS assumes a NO_2 fraction of 10% for all vehicles. The EPA model assigns technology specific NO_2 fractions by vehicle class from European models and data. The total fleet average NO_2 fraction estimated by EPA ranges from 15% to 17% across the speed range.

The EPA recommends the proponent clarify how NO_2 emissions were estimated and, if necessary, revise the aggregated fleet NO_2/NO_X emission estimate to be based on the detailed fleet composition data and best international data on vehicle technology specific NO_2 fractions. If necessary, the proponent should provide a revised air quality impact assessment to account for any changes to the emissions inventory.