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Dear Guy

St Marys Freight Hub Offsite Transport Route Air Quality Assessment

1.0 Introduction

A quantitative Air Quality Impact Assessment (AQIA) was prepared for the operational phase of St Marys Freight Hub (the Project). The AQIA only included an assessment of air emissions due to sources on site. Further investigation of potential air quality amenity impacts was requested by Department of Planning Industry & Environment for trucks transporting goods and materials to and from the Project site along existing public roads in the St Marys area. Additional air dispersion modelling was undertaken to investigate air emissions from Project traffic on these transport routes and potential air quality impacts and loss of amenity. A comparison between existing and proposed traffic conditions was made to determine potential increases in Project-related roadside pollutant concentrations. This letter presents the methodology and findings of the transport route investigation.

2.0 Project Transport Routes

Four route options have been considered for trucks travelling to and from the Project site. The four route options are presented in **Figure 1**. At this stage, Option 4 is the preferred route to be adopted once the Project begins operation. For this assessment, however, not all route options were modelled given that the potential air quality impacts along each of the routes are considered to be similar. This is due to each option having the same number of trucks using each haul route and the trucks would be expected to be travelling at comparable speeds for each route. The Option 4 route uses roads with relatively high existing traffic volumes and receptors along this route would likely be subject to the highest existing pollutant concentrations. Based on this, the Option 4 route was modelled as cumulative results for this route were expected to be conservative, and the outcome of the assessment could be applied conservatively to Options 1, 2 and 3.

A summary of existing daily traffic volumes and proposed Project heavy vehicle volumes for each road section are presented in **Table 1**.

Table 1 Summary of vehicle volumes for relevant road sections

Road Section	Route Option	Daily Existing Light Vehicles	Daily Existing Heavy Vehicles	Daily Project Heavy Vehicles
Mamre Road (between M4 and GWH)	1, 2, 3, 4	22,725	3,598	366
Great Western Highway (east towards CBD)	1, 2, 3, 4	33,869	3,738	65
Glossop Street	1, 3, 4	19,207	3,668	436
Harris Street	3	2,167	343	218
Forrester Road (sth of Glossop)	3, 4	3,891	433	436
Forrester Road (nth of Glossop)	1	20,677	3,129	436
Christie St	1, 2	20,739	2,506	436
Lee Holm Road	1, 2	1,882	733	436
Werrington Rd	2	16,430	2,061	436
Great Western Highway (west towards Penrith)	1, 2, 3, 4	33,869	3,738	371

Figure 1 Truck transport routes from the Project site

The Option 4 route is presented in **Figure 2**. The majority of trucks (73 %) leaving site would use the Forrester Road – Glossop Street - Mamre Road route to the M4 Motorway, before heading east towards central Sydney. Smaller fractions of Project trucks would travel east along Great Western Highway (15 %), south along Mamre Road from the M4 intersection (11 %), and west along the M4 Motorway (1 %). For the purposes of the modelling, only traffic up to the M4 intersection with Mamre Road has been considered.

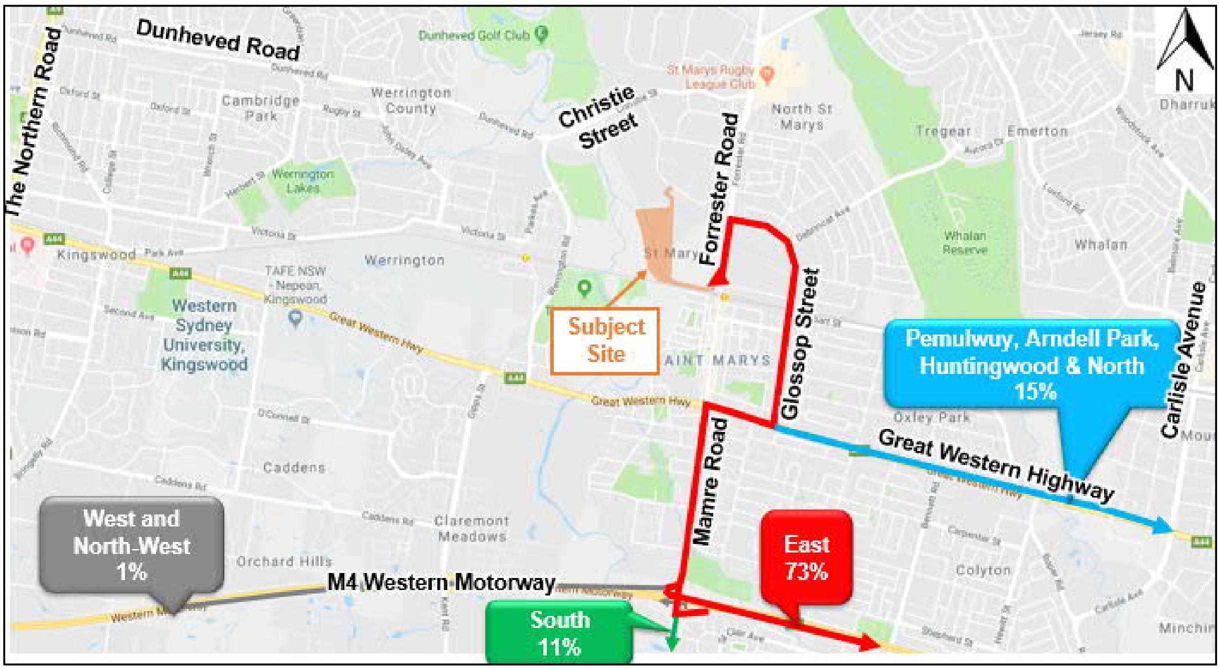

Figure 2 Route Option 4 – fraction of Project trucks for each road

3.0 Air Quality Criteria

To determine the potential effects of general air quality in the air shed, ambient pollutant concentrations can be compared to relevant impact assessment criteria. In NSW, ambient air quality criteria are specified in Table 7.1; Impact assessment criteria of the NSW Environment Protection Authority (EPA) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016) and represent maximum allowable pollution levels at the boundary of the premises. The criteria for the relevant pollutants of concern are reproduced in **Table 2** below. The purpose of this transport route investigation was to assess potential amenity impacts along the transport routes, and therefore air toxics were not included in the modelling.

Table 2 Regulatory air quality criteria (μg/m³)

Pollutant of Concern	Averaging Period	Criteria
Particulate Matter (PM_{10})	Maximum 24 hour average	50 $\mu g/m^3$
	Annual average	25 $\mu g/m^3$
Particulate Matter ($PM_{2.5}$)	Maximum 24 hour average	25 $\mu g/m^3$
	Annual average	8 $\mu g/m^3$
Nitrogen dioxide (NO_2)	Maximum 1 hour average	246 $\mu g/m^3$
	Annual average	62 $\mu g/m^3$
$\mu g/m^3$ = micrograms per cubic metre		

4.0 Modelling methodology

4.1 Model

For consistency the dispersion model CALPUFF, utilised in the original AQIA was used for the transport route investigation. Meteorological data used in this assessment was also consistent with the CALMET data used in the AQIA. Additional details of the model inputs and settings as well as and meteorological data used in the model are presented in the AQIA. Roadside sensitive receptors, source input parameters; and emission rates for the transport route investigation are described below in **Section 4.2** and **Section 4.3**.

4.2 Model Configuration and Sensitive receptors

Line-volume sources were used in the mode to represent the sections of the Option 4 transport route for the Project. Traffic was modelled on Forrester Road, Glossop Street, Great Western Highway and Mamre Road. Sensitive receptors were placed in a gridded pattern along each road section at 17 meters, 40 meters, 100 meters and 200 meters from the road centre lines. The innermost row of receptors at 17 m were spaced at 30 m intervals along the length of each road source. The line volume sources (blue lines) and sensitive receptor grid (purple dots) are presented in **Figure 3**. A close-up of the northern section of the model is presented in **Figure 4**.

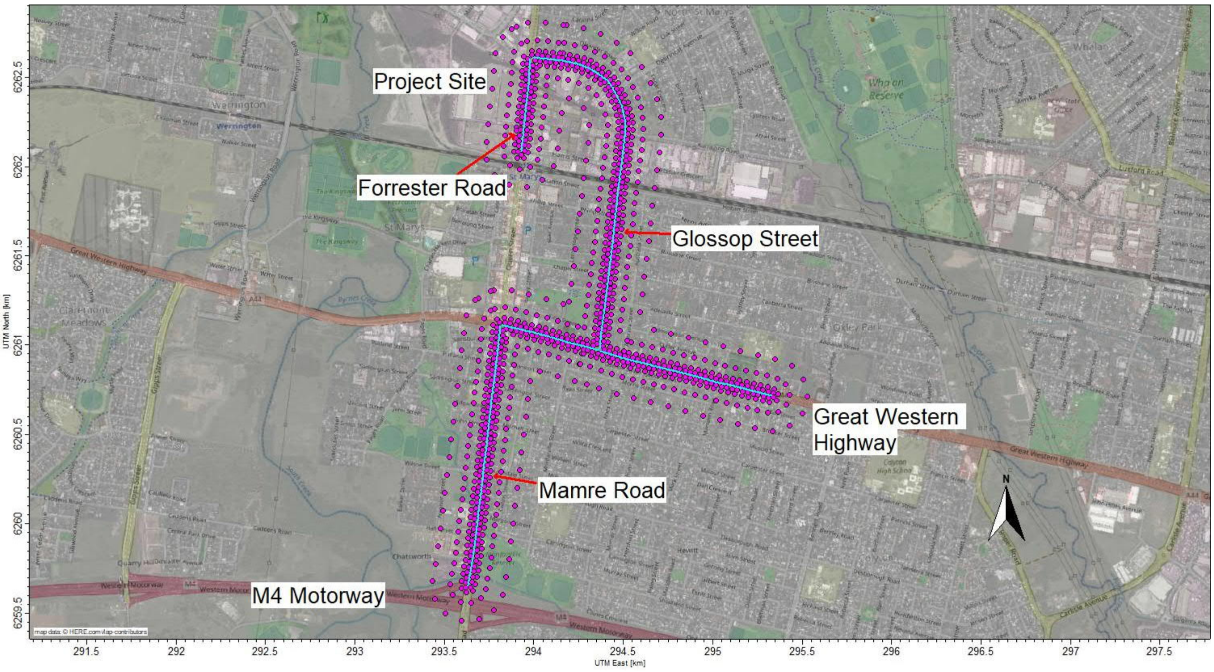

Figure 3 Model sources (blue lines) and sensitive receptor grid (purple dots)

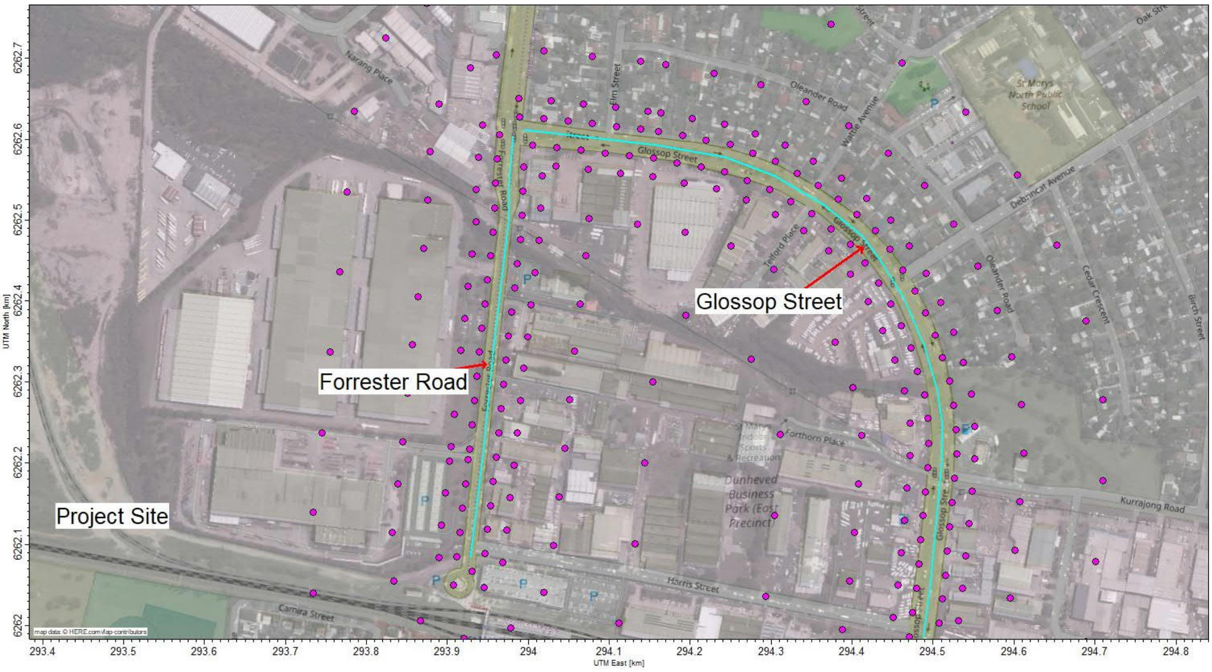

Figure 4 Close-up of receptor grid around Forrester Road and Glossop Street

4.3 Vehicle Emissions

Emissions due to existing traffic on the transport routes and future Project traffic were estimated. The make-up and volume of existing traffic was based on traffic observations taken at various points along the transport routes. The traffic observations data was provided to AECOM by Urbanco. A summary of modelled road parameters, existing traffic volumes and Project traffic volumes are presented in **Table 3**.

Table 3 Modelled road section traffic volumes and parameters

Modelled Road Section[1]	Length (km)	Speed (km/h)[2]	Daily Existing light vehicles	Daily Existing Heavy Vehicles	Percent of Project Traffic	Daily Project Heavy Vehicles
Mamre Road (between M4 and GWH)	1.47	50	22,725	3,598	85	366
Great Western Highway (east)	0.99	50	33,869	3,738	15	65
Glossop Street	1.98	50	19,207	3,668	100	436
Forrester Road	0.52	40	3,891	433	100	436
Great Western Highway (west)	0.56	50	33,869	3,738	85	371

[1]Traffic flow assumed to be same for both directions
[2]From traffic observation data provided by Urbanco – assumed same speed for each direction

Emissions from existing traffic and Project trucks using the transport routes were estimated using emission factors calculated using the COPERT Australia, version 1.3 data set. The following assumptions where made for light and heavy vehicles:

- All light vehicles were assumed to be passenger cars with unleaded petrol engines (ULP) and ADR79-02 emissions technology:
- All existing and Project heavy vehicles were assumed to be diesel powered and use ADR80-02 emissions technology.

A summary of emission factors calculated with COPERT are present for relevant vehicle speeds in **Table 4**.

Table 4 COPERT emission factors

Modelled Road Section	NOx Emission Factor (g/km/vehicle)	$PM_{2.5}$ Emission Factor (g/km/vehicle)
40 km/h cars (ULP)	0.0451	0.0107
50 km/h cars (ULP)	0.1143	0.0124
40 km/h trucks (diesel)	3.581	0.0562
50 km/h trucks (diesel)	3.872	0.0637

Emission rates were varied by hour of day according to traffic volumes on each section of road. A summary of percentages of road traffic by hour of day for the existing traffic and Project trucks is presented in **Table 5**. Existing traffic hourly data were based on 15-minute traffic observations provided by Pacific National.

Table 5 Percentage of traffic on each road section by hour of day

Hour of Day	Existing Traffic - Glossop Street (%)		Existing Traffic - Forrester Road (%)		Existing Traffic - Mamre Road and GWH (%)		Project Traffic (%)
	Cars	Trucks	Cars	Trucks	Cars	Trucks	Trucks
0	0.6	0.7	0.9	0.0	0.7	1.2	0.7
1	0.4	0.2	0.2	0.0	0.4	0.5	0.7
2	0.5	0.7	0.6	2.7	0.4	0.0	0.7
3	0.7	1.2	0.6	0.0	0.7	0.7	1.4
4	1.8	2.1	1.1	0.0	1.7	1.1	1.4
5	3.5	4.5	2.1	13.5	4.2	5.2	3.8
6	4.5	8.6	4.3	13.5	6.1	8.2	3.9
7	5.8	6.1	6.2	2.7	7.4	7.6	6.9
8	7.2	7.3	4.3	10.8	7.3	5.7	6.9
9	5.1	8.2	2.8	2.7	5.7	9.2	6.9
10	3.9	5.8	2.5	2.7	4.5	7.6	6.9
11	4.6	7.9	2.6	8.1	4.5	4.8	6.9
12	4.9	7.9	2.7	5.4	4.6	6.9	6.9
13	4.8	9.4	2.4	13.5	5.3	7.1	6.9
14	7.1	8.0	8.2	10.8	6.2	6.6	6.4
15	9.1	6.1	9.9	5.4	7.0	8.0	6.4
16	8.4	5.1	10.0	0.0	7.1	5.9	6.9
17	8.4	3.3	13.2	2.7	7.8	4.4	6.9
18	5.4	1.9	11.0	2.7	5.6	3.2	2.1
19	3.9	0.9	6.6	0.0	4.1	2.0	3.3
20	3.1	1.0	2.3	0.0	2.9	1.4	3.2
21	2.9	1.0	1.7	2.7	2.3	0.4	2.1
22	1.7	1.0	2.3	0.0	1.9	2.1	1.4
23	1.5	0.9	1.3	0.0	1.3	0.2	0.7

A summary of modelled emission rates for each road section are presented in **Table 6** to **Table 10**. The highest emission rates are generally during the morning and evening peak traffic hours. Nightime (especially early morning) emission rates are lowest, which is expected due to low traffic volumes.

Table 6 Modelled emission rates for Mamre Road

Hour of Day	Mamre Road - Emission Rate (g/s)			
	Existing NO_x	Existing + Project NOx	Existing $PM_{2.5}$	Existing + Project $PM_{2.5}$
0	0.0684	0.0706	0.0018	0.0018
1	0.0299	0.0321	0.0009	0.0009
2	0.0017	0.0039	0.0004	0.0004
3	0.0403	0.0448	0.0013	0.0014
4	0.0632	0.0677	0.0026	0.0027
5	0.2881	0.3003	0.0084	0.0086
6	0.4547	0.4675	0.0128	0.0130
7	0.4321	0.4544	0.0136	0.0140
8	0.3293	0.3516	0.0120	0.0123
9	0.5092	0.5315	0.0133	0.0136
10	0.4201	0.4424	0.0108	0.0111
11	0.2710	0.2932	0.0085	0.0088
12	0.3832	0.4055	0.0103	0.0106
13	0.3956	0.4179	0.0111	0.0115
14	0.3713	0.3921	0.0116	0.0119
15	0.4493	0.4700	0.0136	0.0139
16	0.3377	0.3599	0.0119	0.0122
17	0.2658	0.2880	0.0114	0.0117
18	0.1915	0.1981	0.0082	0.0083
19	0.1199	0.1306	0.0057	0.0059
20	0.0868	0.0972	0.0041	0.0042
21	0.0282	0.0349	0.0026	0.0027
22	0.1201	0.1246	0.0037	0.0038
23	0.0148	0.0170	0.0014	0.0015

Table 7 Modelled emission rates for Great Western Highway (East)

Hour of Day	Great Western Highway (East) - Emission Rate (g/s)			
	Existing NO_x	Existing + Project NOx	Existing $PM_{2.5}$	Existing + Project $PM_{2.5}$
0	0.0489	0.0491	0.0015	0.0015
1	0.0215	0.0218	0.0008	0.0008
2	0.0017	0.0020	0.0004	0.0004
3	0.0292	0.0297	0.0011	0.0011
4	0.0465	0.0471	0.0023	0.0024
5	0.2072	0.2087	0.0071	0.0072
6	0.3264	0.3280	0.0108	0.0108
7	0.3122	0.3149	0.0118	0.0118
8	0.2402	0.2428	0.0106	0.0107
9	0.3641	0.3668	0.0110	0.0111
10	0.3002	0.3028	0.0089	0.0089
11	0.1957	0.1984	0.0073	0.0073
12	0.2744	0.2771	0.0086	0.0086
13	0.2840	0.2867	0.0094	0.0095

Hour of Day	Great Western Highway (East) - Emission Rate (g/s)			
	Existing NO_x	Existing + Project NOx	Existing $PM_{2.5}$	Existing + Project $PM_{2.5}$
14	0.2681	0.2707	0.0100	0.0101
15	0.3238	0.3263	0.0116	0.0117
16	0.2457	0.2484	0.0105	0.0105
17	0.1961	0.1988	0.0103	0.0104
18	0.1413	0.1421	0.0075	0.0075
19	0.0893	0.0906	0.0053	0.0053
20	0.0646	0.0658	0.0037	0.0038
21	0.0226	0.0234	0.0025	0.0025
22	0.0866	0.0872	0.0032	0.0032
23	0.0120	0.0123	0.0014	0.0014

Table 8 Modelled emission rates for Glossop Street)

Hour of Day	Glossop Street - Emission Rate (g/s)			
	Existing NO_x	Existing + Project NOx	Existing $PM_{2.5}$	Existing + Project $PM_{2.5}$
0	0.0537	0.0573	0.0015	0.0016
1	0.0146	0.0181	0.0006	0.0007
2	0.0530	0.0566	0.0014	0.0014
3	0.0920	0.0992	0.0022	0.0023
4	0.1604	0.1676	0.0044	0.0045
5	0.3461	0.3657	0.0092	0.0095
6	0.6422	0.6628	0.0148	0.0152
7	0.4708	0.5067	0.0135	0.0140
8	0.5665	0.6023	0.0165	0.0171
9	0.6200	0.6559	0.0152	0.0157
10	0.4367	0.4726	0.0110	0.0116
11	0.5918	0.6277	0.0141	0.0147
12	0.5934	0.6293	0.0145	0.0151
13	0.7070	0.7429	0.0162	0.0167
14	0.6167	0.6502	0.0172	0.0177
15	0.4869	0.5203	0.0173	0.0178
16	0.4077	0.4436	0.0154	0.0159
17	0.2809	0.3168	0.0133	0.0139
18	0.1653	0.1760	0.0084	0.0085
19	0.0820	0.0992	0.0054	0.0057
20	0.0909	0.1077	0.0047	0.0050
21	0.0901	0.1008	0.0045	0.0047
22	0.0840	0.0912	0.0031	0.0032
23	0.0705	0.0741	0.0027	0.0028

Table 9 Modelled emission rates for Forrester Road

Hour of Day	Forrester Road - Emission Rate (g/s)			
	Existing NO_x	Existing + Project NOx	Existing $PM_{2.5}$	Existing + Project $PM_{2.5}$
0	0.0006	0.0016	0.0001	0.0001
1	0.0001	0.0012	0.0000	0.00004
2	0.0070	0.0080	0.0002	0.0002
3	0.0004	0.0025	0.0000	0.0001
4	0.0007	0.0027	0.0001	0.0001
5	0.0343	0.0399	0.0007	0.0008
6	0.0357	0.0416	0.0008	0.0009
7	0.0106	0.0208	0.0005	0.0007
8	0.0291	0.0394	0.0007	0.0009
9	0.0084	0.0186	0.0003	0.0005
10	0.0082	0.0184	0.0003	0.0004
11	0.0214	0.0317	0.0005	0.0007
12	0.0149	0.0251	0.0004	0.0006
13	0.0344	0.0447	0.0007	0.0009
14	0.0316	0.0412	0.0010	0.0012
15	0.0196	0.0291	0.0009	0.0011
16	0.0065	0.0167	0.0007	0.0009
17	0.0151	0.0253	0.0010	0.0012
18	0.0137	0.0167	0.0009	0.0009
19	0.0043	0.0092	0.0005	0.0005
20	0.0015	0.0063	0.0002	0.0002
21	0.0077	0.0107	0.0002	0.0003
22	0.0015	0.0035	0.0002	0.0002
23	0.0008	0.0019	0.0001	0.0001

Table 10 Modelled emission rates for Great Western Highway (West)

Hour of Day	Great Western Highway (West) - Emission Rate (g/s)			
	Existing NO_x	Existing + Project NOx	Existing $PM_{2.5}$	Existing + Project $PM_{2.5}$
0	0.0006	0.0016	0.0001	0.0001
1	0.0001	0.0012	0.0000	0.00004
2	0.0070	0.0080	0.0002	0.0002
3	0.0004	0.0025	0.0000	0.0001
4	0.0007	0.0027	0.0001	0.0001
5	0.0343	0.0399	0.0007	0.0008
6	0.0357	0.0416	0.0008	0.0009
7	0.0106	0.0208	0.0005	0.0007
8	0.0291	0.0394	0.0007	0.0009
9	0.0084	0.0186	0.0003	0.0005
10	0.0082	0.0184	0.0003	0.0004
11	0.0214	0.0317	0.0005	0.0007
12	0.0149	0.0251	0.0004	0.0006
13	0.0344	0.0447	0.0007	0.0009

Hour of Day	Great Western Highway (West) - Emission Rate (g/s)			
	Existing NO_x	Existing + Project NOx	Existing $PM_{2.5}$	Existing + Project $PM_{2.5}$
14	0.0316	0.0412	0.0010	0.0012
15	0.0196	0.0291	0.0009	0.0011
16	0.0065	0.0167	0.0007	0.0009
17	0.0151	0.0253	0.0010	0.0012
18	0.0137	0.0167	0.0009	0.0009
19	0.0043	0.0092	0.0005	0.0005
20	0.0015	0.0063	0.0002	0.0002
21	0.0077	0.0107	0.0002	0.0003
22	0.0015	0.0035	0.0002	0.0002
23	0.0008	0.0019	0.0001	0.0001

5.0 Results

A summary of highest predicted roadside pollutant concentrations for the existing traffic and existing traffic plus Project trucks is presented in **Table 11**. Percentage increase in pollutant concentrations due to Project trucks are provided. The results show that a very small (<1%) increase in Maximum 24 Hour and annual average roadside $PM_{2.5}$ concentrations and peak (1-hour) NO_2 concentrations due to Project trucks travelling along modelled the transport routes. A slight increase of around 2.8 % was predicted for the maximum annual NO_2 concentration to occur at a sensitive receptor.

Incremental increases in maximum 24 hour and annual average local $PM_{2.5}$ concentrations are essentially negligible (about 0.1 µg/m^3) due to Project trucks on the transport routes. Most of the particulate emissions from trucks are in the $PM_{2.5}$ fraction, and therefore PM_{10} and TSP emissions will be only marginally more than the $PM_{2.5}$ emissions. The percentage increase in PM_{10} and TSP concentrations due to the Project will therefore also be negligible. Air quality impacts and associated loss of amenity due to Project related trucks using the transport routes in and out form the Project site are therefore negligible.

Table 11 Summary of model results – road sources only (no background) – Option 4 route

Pollutant	Averaging Period	Highest Predicted Concentration at a Roadside Receptor (µg/m^3) – Roads only		Increase (%) Due to Project Trucks
		Existing Traffic	Existing Traffic plus Project Trucks	
$PM_{2.5}$	Max. 24-hour	3.7	3.8	1.0
	Annual	1.5	1.5	<1
NO_2[1]	Max. 1-hour	136.1	137.2	<1
	Annual	17.8	18.3	2.8

Cumulative (including background concentrations) results for existing traffic and existing traffic plus Project trucks are presented in **Table 12**. The background concentrations for $PM_{2.5}$ were taken from the previous AQIA - 23.5 µg/m^3 for the 24-hour average and 7.8 µg/m^3 for the annual average (see AQIA for details on the background concentrations). Cumulative NO_2 concentrations were calculated using the Ozone Limiting Method (OLM) and utilised background NO_2 and ozone data for the year 2016 from the St Marys OEH monitoring station. The cumulative results are indictive of potential transport route impacts on air quality only, as only the road sources have been included (i.e. no Project onsite sources). It should also be noted that cumulative impacts are considered conservative as there is likely a degree of double counting between the existing traffic sources and the background concentrations. As such consideration of the predicted maximum incremental contribution from trucks from the project shown in **Table 11** should also be acknowledged when accounting for predicted cumulative impacts.

Table 12 Summary of model results – cumulative – Option 4 route

Pollutant	Averaging Period	Highest Predicted Concentration at a Roadside Receptor (µg/m³) – Cumulative		Criteria (µg/m³)
		Existing Traffic	Existing Traffic plus Project Trucks	
$PM_{2.5}$	Max. 24-hour	**27.2**	**27.3**	25
	Annual	**9.3**	**9.3**	8
NO_2[1]	Max. 1-hour	166.2	167.3	246
	Annual	25.0	25.5	62

[1]NO_2 concentrations calculated using the OLM method – 2-16 NO_2 and ozone data were sourced from OEH St Marys station

The results presented here are for receptors along the Option 4 route. In general, the existing traffic volumes along the Option 4 route are higher than those on the other options. For example, the Option 2 route along Lee Holm Road, Christie Street, and Werrington Road has slightly lower existing traffic volumes (see **Table 1**) than the Option 4 route. Pollutant concentrations along the Option 2 route would in general be lower than those predicted for Option 4 due to the slightly lower existing traffic volumes. Absolute increases in roadside pollutant concentrations along the Option 2 (or Option 1 or 3) route would be similar to those predicted in this assessment due to the same volume of Project trucks that would travel along Option 2 route. The relative increase (as a percentage of existing pollutant concentrations) would be slightly higher than the relative Project increment presented in **Table 11** and **Table 12**, however it is still likely to be very low.

6.0 Conclusion

The modelling of the Option 4 transport route showed that compared with existing traffic on the roads, an almost negligible increase in local pollutant concentrations is likely due to Project trucks. The results can be extrapolated to the other route options, Option 1, Option 2 and Option 3, due to lower Air quality impacts and associated loss of amenity along the transport routes due to the Project are likely to be negligible.

Yours faithfully

Julian Ward
Air Quality Scientist