

DATE 22 August 2017

PROJECT No. 1521107-259-TM-Rev0

SURFACE ROAD MODELLING INCLUDING TYRE AND BRAKE WEAR PARTICULATE MATTER

As noted in my expert witness statement response to Item LD2-R (Appendix D of the *Preliminary Matters and Further Information Request* issued by the West Gate Tunnel Project IAC) modelling predictions for West Gate Freeway and Francis Street were to be provided by Golder to the IAC, including the impact of particulate matter resulting from tyre and brake wear.

The West Gate Tunnel Project (WGTP) Environment Effects Statement assessed the impact of surface roads based on vehicle exhaust emissions only. The major purpose of the surface roads air quality assessment was to enable a comparison between the 'without project' (base) and 'with project' (project) cases. However a sensitivity analysis was conducted for the West Gate Freeway and Francis Street including non-exhaust emissions (tyre and brake wear).

Methodology

The World Road Association (PIARC) publishes emission factors for PM_{2.5} non-exhaust emissions (tyre and brake wear) for passenger cars (PC), light commercial vehicles (LCV) and heavy commercial vehicles (HCV) which are independent of vehicle speed (Table 1).

Table 1: PIARC PM_{2.5} Non-Exhaust Emission Factors

Emission Type	PC/LCV	HCV
	(mg/km)	(mg/km)
Non-exhaust PM _{2.5}	28	104

For the purposes of modelling, PM₁₀ emission factors were derived from the sum of PIARC PM_{2.5} exhaust and non-exhaust emission factors, multiplied by a factor of approximately 1.8. This factor was based on in-stack emission data for an existing Australian road tunnel.

Dispersion modelling of combined exhaust and non-exhaust emissions for PM₁₀ and PM_{2.5} was conducted for Francis Street and the West Gate Freeway using AUSROADS.

Results

Table 2 presents the predicted ground level concentrations (GLCs) for exhaust emissions and combined emissions (exhaust and non-exhaust emissions) with the background concentration included. Figure 1 presents plots of exhaust and combined emissions together with the SEPP(AQM) intervention levels.

The results indicate that with non-exhaust emissions included for Francis Street, there is an increase in predicted maximum concentrations of approximately 9 to 13 µg/m³ PM₁₀ and 7 to 8 µg/m³ PM_{2.5} for both the base and project cases across 2022 and 2031.

For West Gate Freeway the results indicate that with non-exhaust emissions included, there is an increase in predicted maximum concentrations of approximately 15 to 20 µg/m³ PM₁₀ and 12 to 16 µg/m³ PM_{2.5} for both the base and project cases across 2022 and 2031.

Table 2: Maximum Predicted PM₁₀ & PM_{2.5} GLC with Background

Year	2022				2031			
	PM ₁₀ (µg/m ³)		PM _{2.5} (µg/m ³)		PM ₁₀ (µg/m ³)		PM _{2.5} (µg/m ³)	
	24 hour average		24 hour average		24 hour average		24 hour average	
Road	Base	Project	Base	Project	Base	Project	Base	Project
Francis St - Exhaust	61	60	11	9.1	61	60	11	9.4
Francis St - Exhaust & non-exhaust	72	69	18	15	74	70	19	16
West Gate Fwy - Exhaust	62	63	12	12	63	63	13	13
West Gate Fwy - Exhaust & non-exhaust	77	80	24	26	79	83	27	29
Intervention Level	60	60	36	36	60	60	36	36

Legend	Decrease	Increase	No Change
--------	----------	----------	-----------

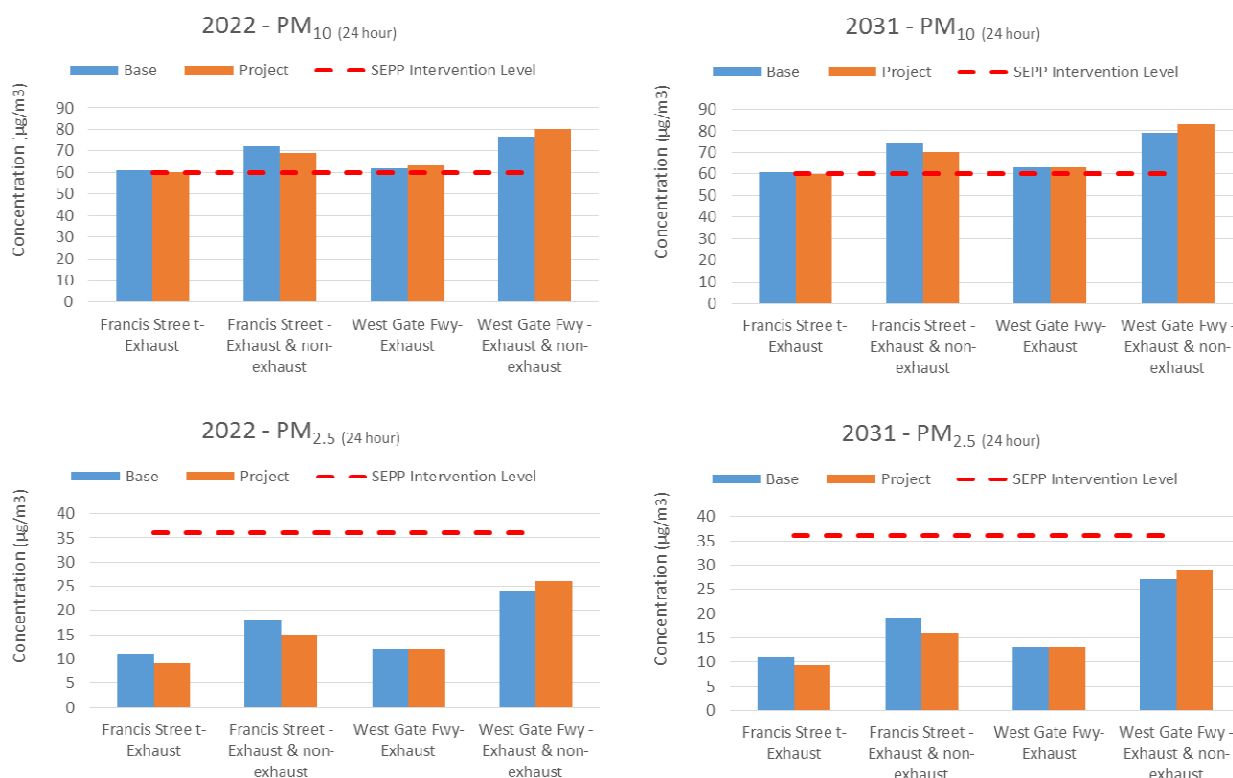


Figure 1: PM₁₀ and PM_{2.5} Exhaust Emissions and Combined Emissions

Figure 2 presents the incremental change in PM₁₀ with the project (project minus base) for Francis Street and West Gate Freeway for exhaust emissions and combined emissions. The figure illustrates that there is an increase in PM₁₀ concentration on West Gate Freeway with the project and a decrease in PM₁₀ concentration on Francis Street with the project. The magnitude of the changes are the similar across both years for the West Gate Freeway and Francis Street.

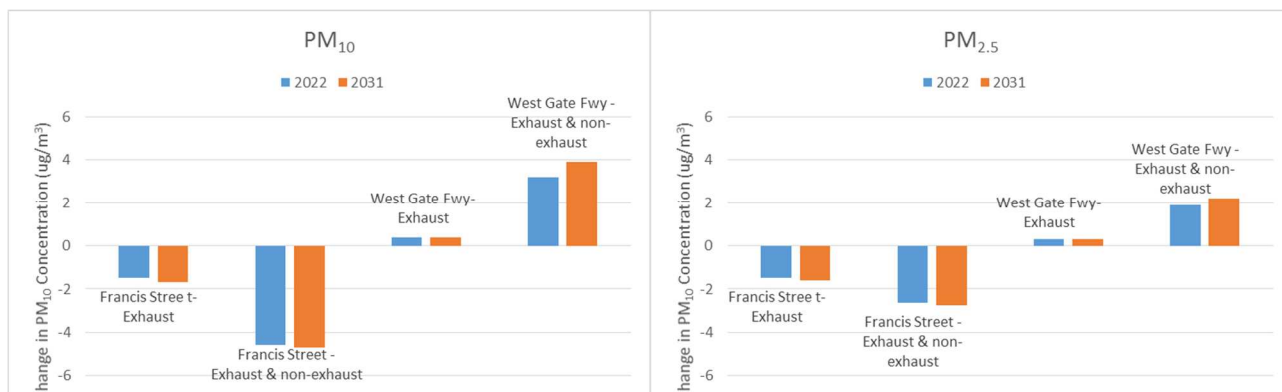


Figure 2: Change in PM₁₀ and PM_{2.5} Concentration with Project

Figure 3 to Figure 6 presents West Gate Freeway PM₁₀ and PM_{2.5} time series plots for exhaust emissions only and combined emissions for 2022 and 2031.

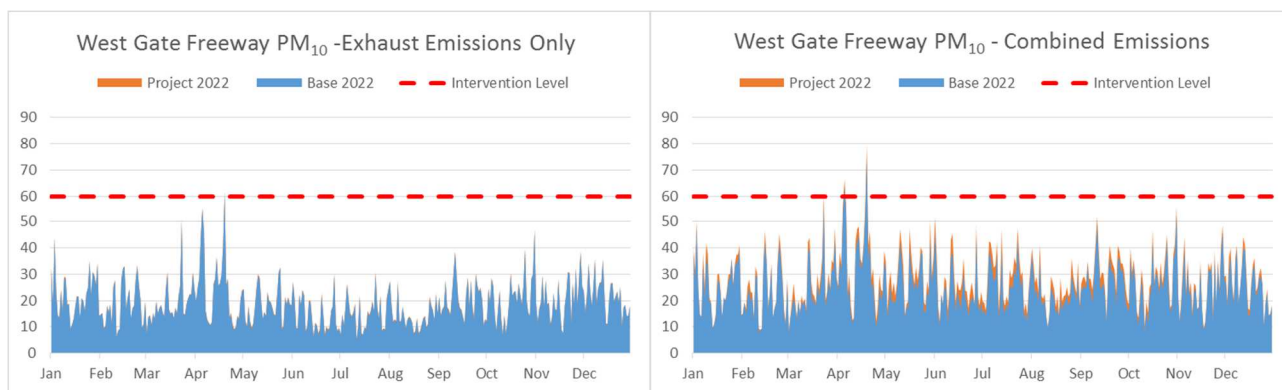


Figure 3: PM₁₀ Time Series - West Gate Freeway – 2022

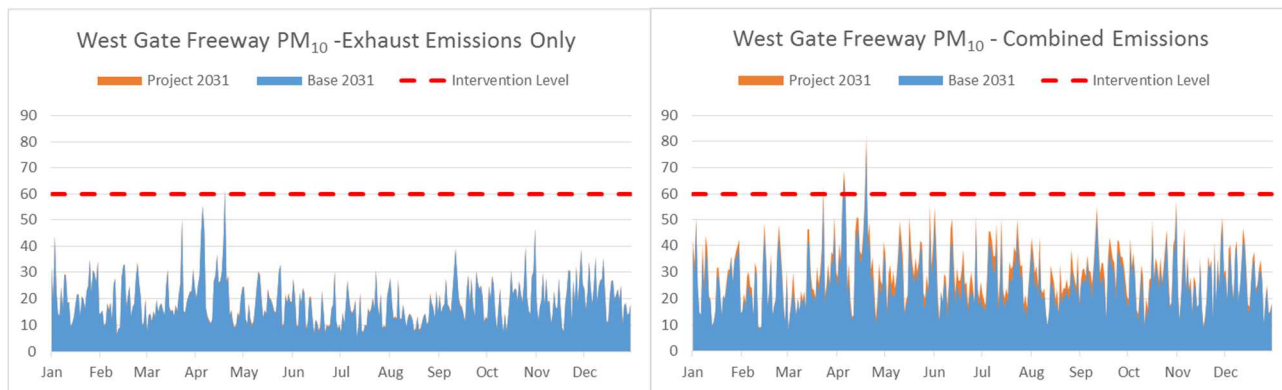


Figure 4: PM₁₀ Time Series - West Gate Freeway – 2031

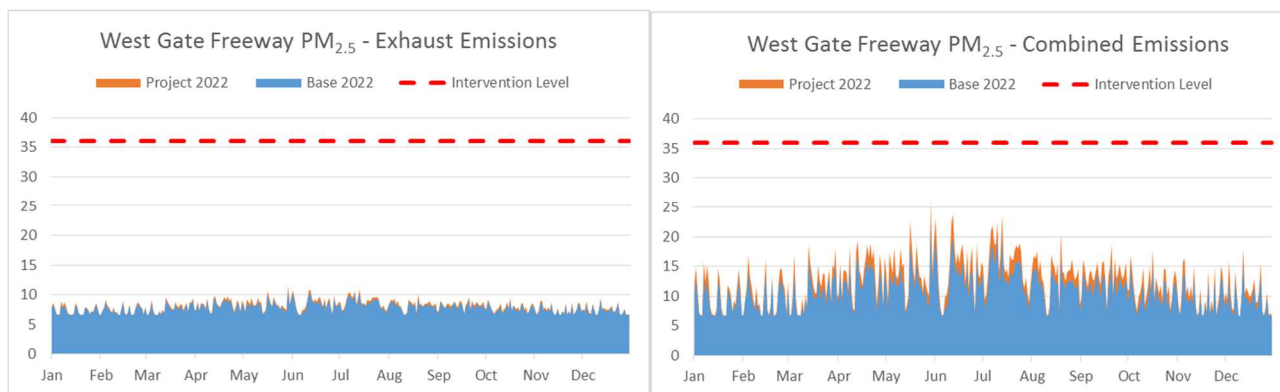


Figure 5: PM_{2.5} Time Series - West Gate Freeway – 2022

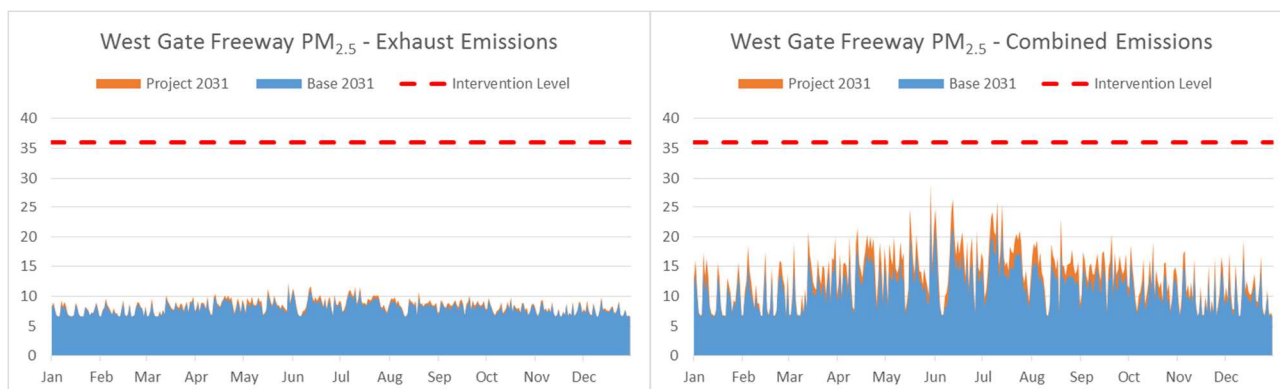


Figure 6: PM_{2.5} Time Series - West Gate Freeway – 2031

Comparison of the exhaust and combined emissions plots for West Gate Freeway shows that the average increase in PM₁₀ with combined emissions is approximately 6 µg/m³ for the base case and 8 µg/m³ for the project case in 2022 and approximately 7 µg/m³ for the base case and 10 µg/m³ for the project case in 2031. The number of exceedances of the intervention level with combined emissions, increases from two to three per year with the project in both 2022 and 2031 compared to one exceedance for both the base case and project case in 2022 and 2031 with exhaust emissions only.

For PM_{2.5} the average increase with combined emissions is approximately 3 µg/m³ for the base case and 4 µg/m³ for the project case in 2022 and approximately 4 µg/m³ for the base case and 5 µg/m³ for the project case in 2031. There were no exceedances of the PM_{2.5} intervention level with either exhaust emissions or combined emissions for either year.

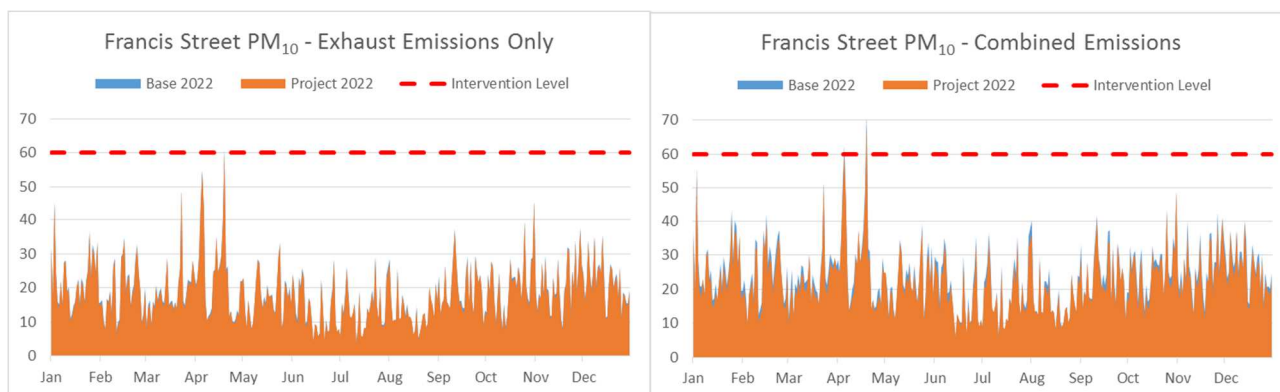


Figure 7: PM₁₀ Time Series - Francis Street - 2022

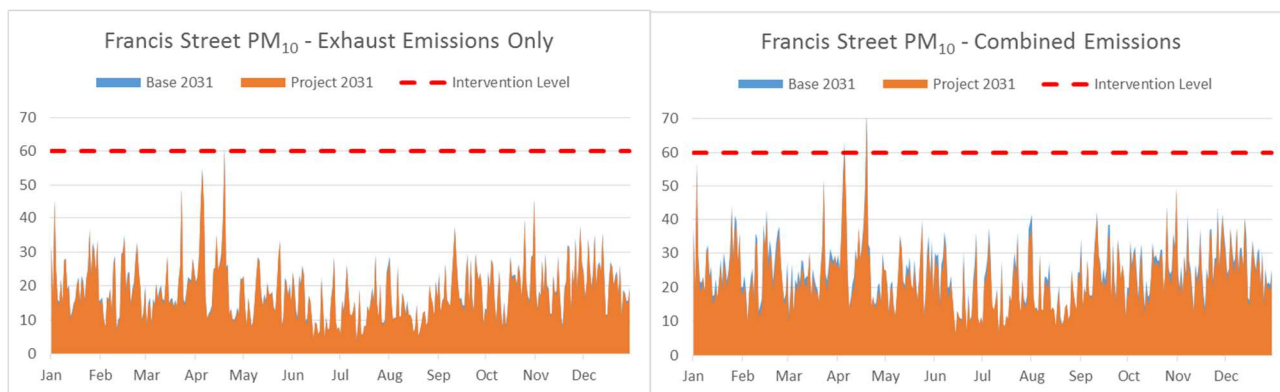


Figure 8: PM₁₀ Time Series - Francis Street - 2031

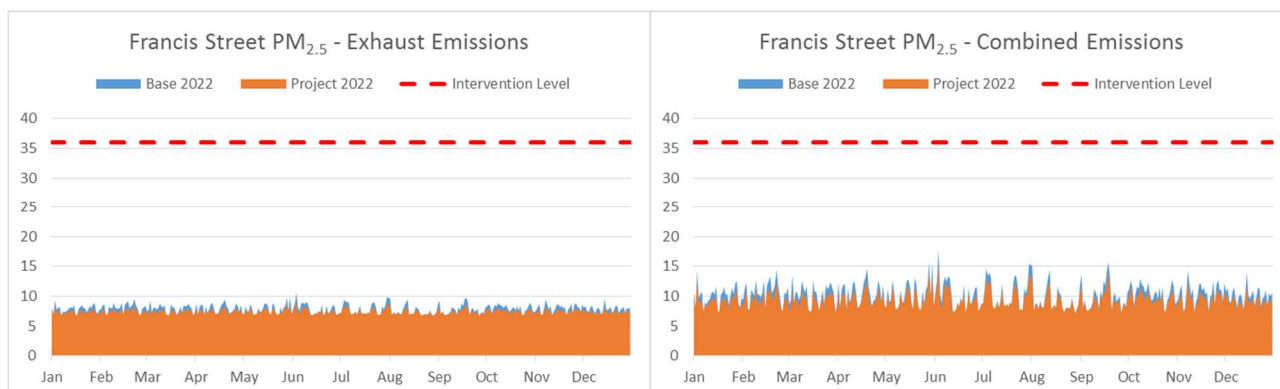


Figure 9: PM_{2.5} Time Series - Francis Street - 2022

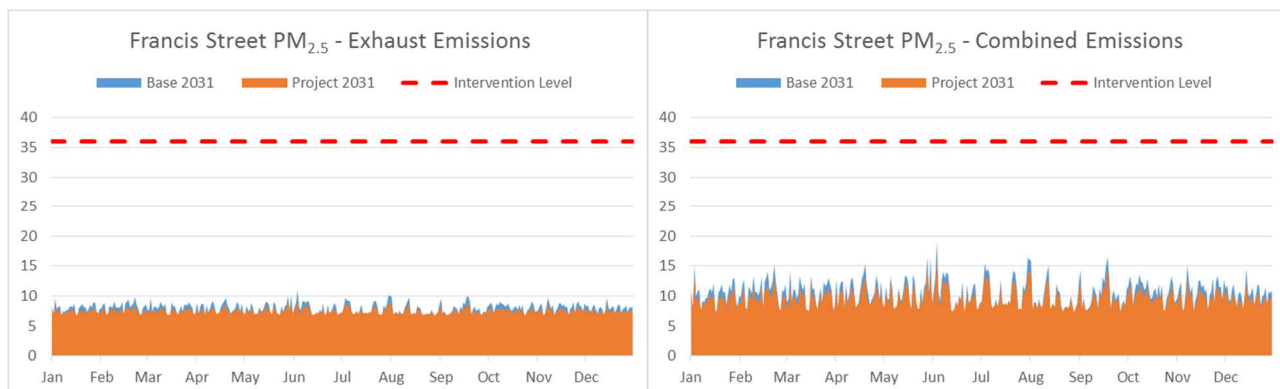


Figure 10: PM_{2.5} Time Series - Francis Street - 2031

Comparison of the exhaust and combined emissions plots for Francis Street shows that the average increase in PM₁₀ with combined emissions is approximately 5 µg/m³ for the base case and 4 µg/m³ for the project case in 2022 and approximately 5.5 µg/m³ for the base case and 4.5 µg/m³ for the project case in 2031.

The number of exceedances of the intervention level with combined emissions, decreases from two to one per year with the project in 2022 compared to a decrease of one to none per year with exhaust emissions only. For 2031, the number of exceedances of the intervention level with combined emissions remains at two per year for the base and project cases compared to one exceedance for both the base and project cases with exhaust emissions only.

For PM_{2.5} the average increase with combined emissions is approximately 2.4 µg/m³ for the base case and 2 µg/m³ for the project case in 2022 and approximately 2.6 µg/m³ for the base case and 2.2 µg/m³ for the

project case in 2031. There were no exceedances of the PM_{2.5} intervention level with either exhaust emissions or combined emissions for either year.

Conclusion

The inclusion of non-exhaust emissions into the surface roads air quality assessment found that:

- Predicted PM₁₀ and PM_{2.5} concentrations increase by similar amounts for the base and project cases across both years modelled.
- Francis Street - The maximum predicted PM₁₀ concentration increases by approximately 9 µg/m³ to 13 µg/m³ for the base and project cases across both years.
- Francis Street - The maximum predicted PM_{2.5} concentration increases by approximately 6 µg/m³ to 8 µg/m³ for the base and project cases across both years.
- Francis Street - There was an increase in the exceedances of the PM₁₀ intervention level from one to two events per year for the base case and an increase from zero to one events per year for the project case in 2022.
- Francis Street - There was an increase in the exceedances of the PM₁₀ intervention level from one to two events per year for the base and project cases in 2031.
- Francis Street - There were no exceedances of the PM_{2.5} intervention level for the base or project cases.
- West Gate Freeway - The maximum predicted PM₁₀ concentration increases by approximately 15 µg/m³ to 20 µg/m³ for the base and project cases across both years.
- West Gate Freeway - The maximum predicted PM_{2.5} concentration increases by approximately 12 µg/m³ to 16 µg/m³ for the base and the project cases across both years.
- West Gate Freeway - There was an increase in the exceedances of the PM₁₀ intervention level from one to two events per year for the base case and from one to three events per year for the project in 2022 and 2031.
- West Gate Freeway - There were no exceedances of the PM_{2.5} intervention level for the base or project cases.

Non-exhaust emissions are expected to be higher along the West Gate Freeway due to the larger number of vehicles. There is an average PM₁₀ increase of 3 µg/m³ with the project including non-exhaust emissions which results in one additional exceedance of the PM₁₀ intervention level.

Limitations

Your attention is drawn to the document, Important Information Relating to this Report (LEG04, RL2), which is attached to this report. The statements presented in this document are intended to advise you of what your realistic expectations of this technical report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this letter are aware of the responsibilities each assumes in so doing. We would be pleased to answer any questions the reader may have regarding this document.



Mark Tulau
Senior Air Quality Scientist
MDT/FEF/mdt



Frank Fleer
Principal Air & Noise Group

c:\users\ffleer\documents\1521107 - western distributor\1521107-259-tm-rev0 -surface roads non-exhaust emissions.docx