

AIR MONITORING AT FRANCIS STREET, YARRAVILLE

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SUMMARY

Local air quality was monitored in Francis Street, Yarraville in June and July 2001. The results indicate airborne particle concentrations which may impact on the health of local residents with pre-existing health conditions, particularly on days with still weather conditions. The sources of the particles are most likely the large number of vehicles travelling along Francis Street, in particular large diesel trucks. The measured particle levels were higher than at other EPA monitoring sites including adjacent to a major arterial road.

Other pollutants do not represent concern at the concentrations measured.

The monitoring suggests that action should be taken to reduce the sources of airborne particles. The results provide a basis for assessing any action (eg. traffic management) taken over time to reduce the sources of pollutants, and for comparison with any other roadside monitoring. Further studies are required to further assess their significance.

OBJECTIVE

The objectives of this program were to:

- assess the local air quality at Francis Street Yarraville;
- determine if the pollutant concentrations at this location were significantly different from other areas in Melbourne; and

- to provide a basis to measure air quality over time.

BACKGROUND

Local residents in the Francis Street, Yarraville area are concerned with the increased level of heavy diesel truck traffic and attendant degradation of their local environment. Concerns relate to the potential detrimental health effects from exposure to airborne particles emitted from trucks and a loss of amenity due to traffic noise. The volume of traffic along Francis Street during a typical weekday day is approximately 16,000 vehicles, of which 25 to 30 per cent is diesel commercial traffic.

METHODOLOGY

EPA Victoria's mobile air monitoring laboratory was employed to monitor the local air quality in Francis Street Yarraville, approximately five metres from the kerb in front of the Yarraville Community Centre. There are residential houses in Francis Street within about four to eight metres of the kerb. The program was conducted during late June and July 2001. The pollutants measured were particles (PM_{10}), fine particles ($PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO) and sulfur dioxide (SO_2). PM_{10} particles were measured by two techniques; manual collection of particles onto a pre-weighed filter over a 24-hour period followed by analysis in the laboratory, and a continuous instrumental technique (TEOM PM_{10}). The manual method is the reference

method for assessing compliance with air quality goals. It was used to measure the local air quality, and the continuous method for comparison to EPA's fixed site monitoring stations in Lord St, Richmond and Wingrove St, Alphington. These sites provide the best data set for such comparison purposes.

The local air quality assessment and comparison of the monitoring results for the different sites were based on the averaging periods specified in the State Environment Protection Policy (Air Quality Management) [SEPP (AQM)]¹. These averaging periods were one hour fixed average for nitrogen dioxide, carbon monoxide and sulphur dioxide and 24-hour fixed average for particles (PM₁₀ & PM_{2.5}). Intervention Levels in the SEPP (AQM) were used to assess whether there are local air pollution problems of concern. These Intervention Levels are risk-based concentrations designed for the protection of human health.

¹State Environment Protection Policy (Air Quality Management) Background Paper. *Indicators for Air Quality Management and Criteria for Assessment 1999*, Government of Victoria.

RESULTS

Particles (PM₁₀)

The 24-hour average PM₁₀ particle concentration during the monitored period ranged from 12 µg/m³ to 69 µg/m³ (Figure 1). The SEPP (AQM) Intervention Level is 60 µg/m³ over a 24 hour average. This Intervention Level was exceeded on four days, 2, 3, 24 and 26 July 2001. There was a further day (25 July) that recorded concentrations at the Intervention Level.

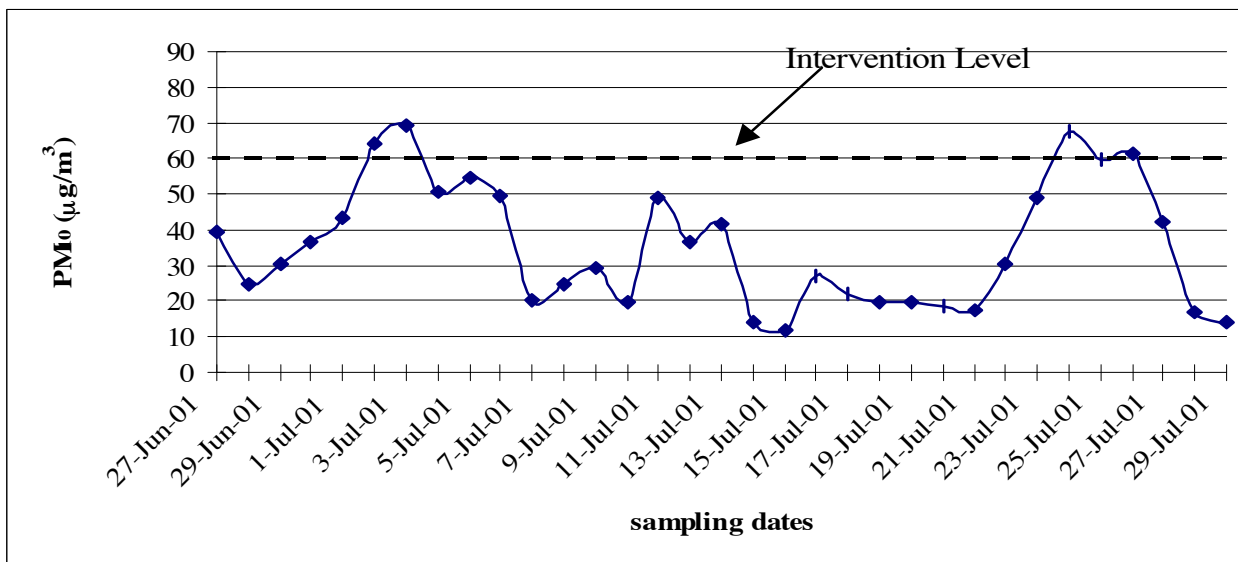


Figure 1. 24 hour average particle (PM₁₀) concentrations at Francis Street site.

The PM₁₀ concentrations measured at the site were dependent on the prevailing weather conditions. Generally, higher particle concentrations were associated with lower wind speed and lower temperatures, as depicted in Figure 2 and Figure 3. The exceptions to this trend occurred on weekends and are likely to reflect the reduced traffic volume compared to weekdays. Low wind speed and low temperature are typically associated with air inversions which are conducive to poor dispersion of pollutants in the air.

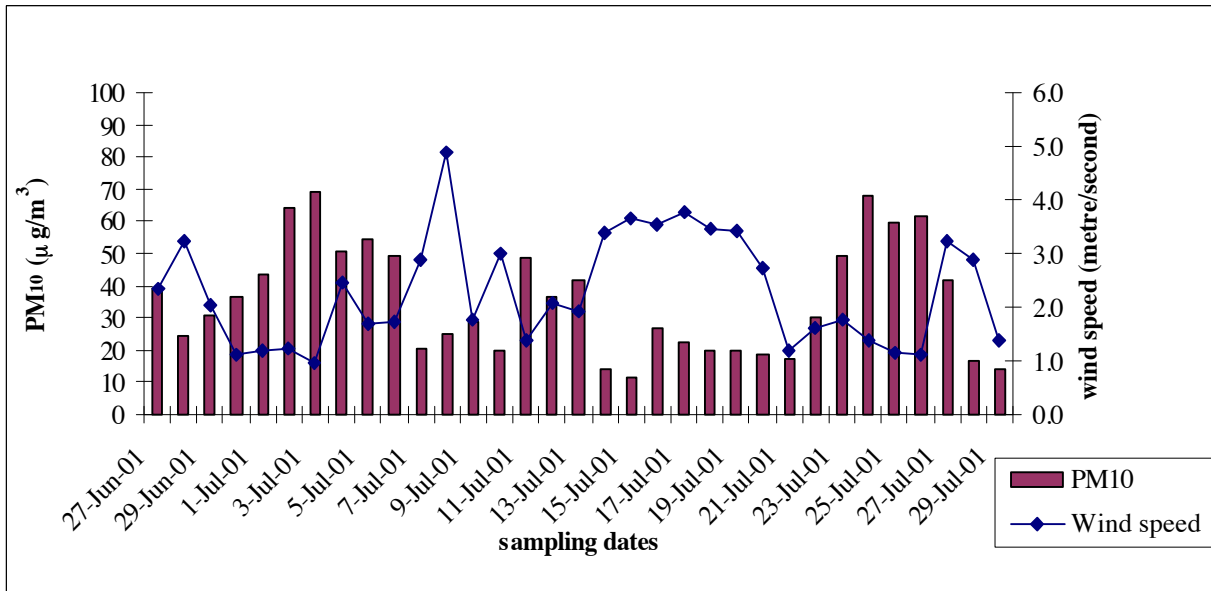


Figure 2. 24-hour average particle (PM₁₀) concentrations and average wind speed at Francis Street site.

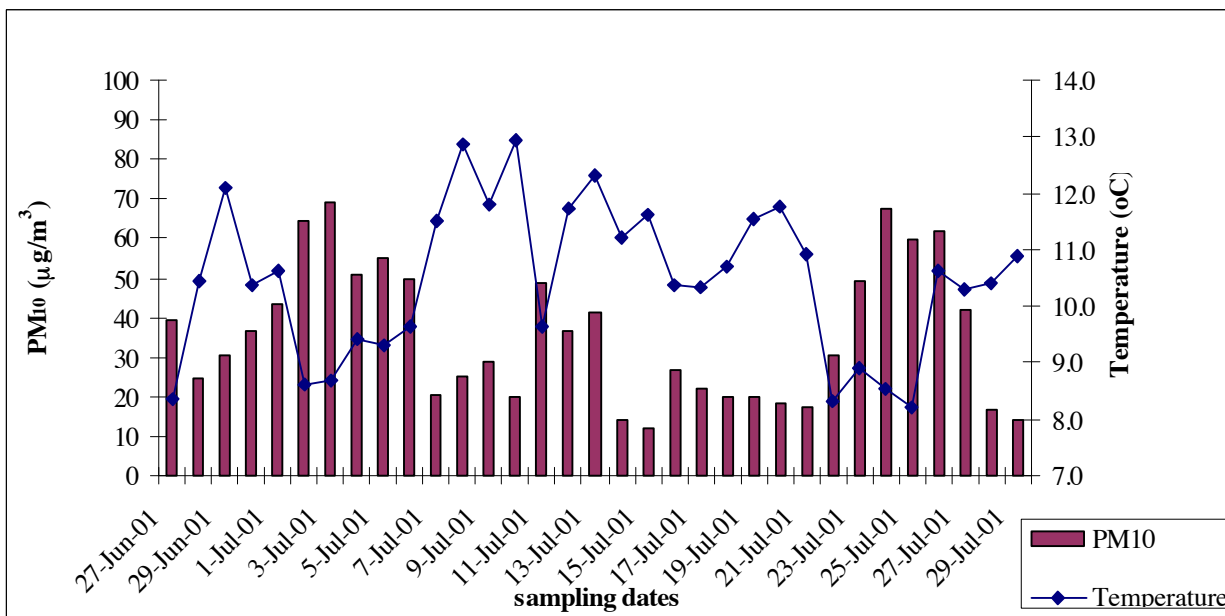


Figure 3. 24-hour average particle (PM₁₀) concentrations and average temperature at Francis Street site.

Fine Particles (PM_{2.5})

The 24-hour average PM_{2.5} concentration ranged from 5 µg/m³ to 45 µg/m³, as shown in Figure 4. The SEPP (AQM) Intervention Level is 36 µg/m³ over a 24-hour average. This Intervention Level was exceeded on five days, 2, 3, 24, 25 and 26 July 2001 and there was a further day (23 July) that recorded concentrations at the Intervention Level.

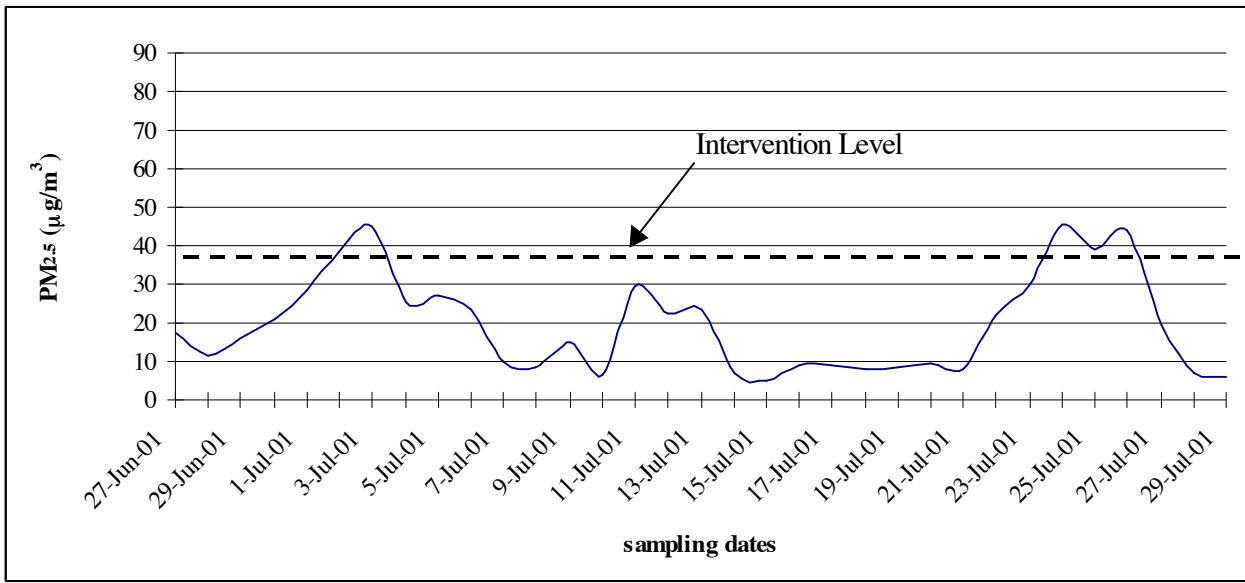


Figure 4. 24 hour average fine particle (PM_{2.5}) concentrations at Francis Street site.

The proportion of fine PM_{2.5} particles in the PM₁₀ particles measured was estimated to range from 33 per cent to 86 per cent, with a mean of 53 per cent. The PM_{2.5} particle proportion on the days when the concentrations exceeded the Intervention Level ranged from 60 per cent to 72 per cent. The high PM_{2.5} particle proportion suggests the particles are from combustion sources such as emissions from diesel vehicles, wood smoke and industrial processes. The concentrations of both PM_{2.5} and PM₁₀ plotted in Figure 5 indicate a similar trend for both suggesting a common source. Exceedances of the Intervention Levels generally occur on the same day and weather conditions, again, suggesting a common source.

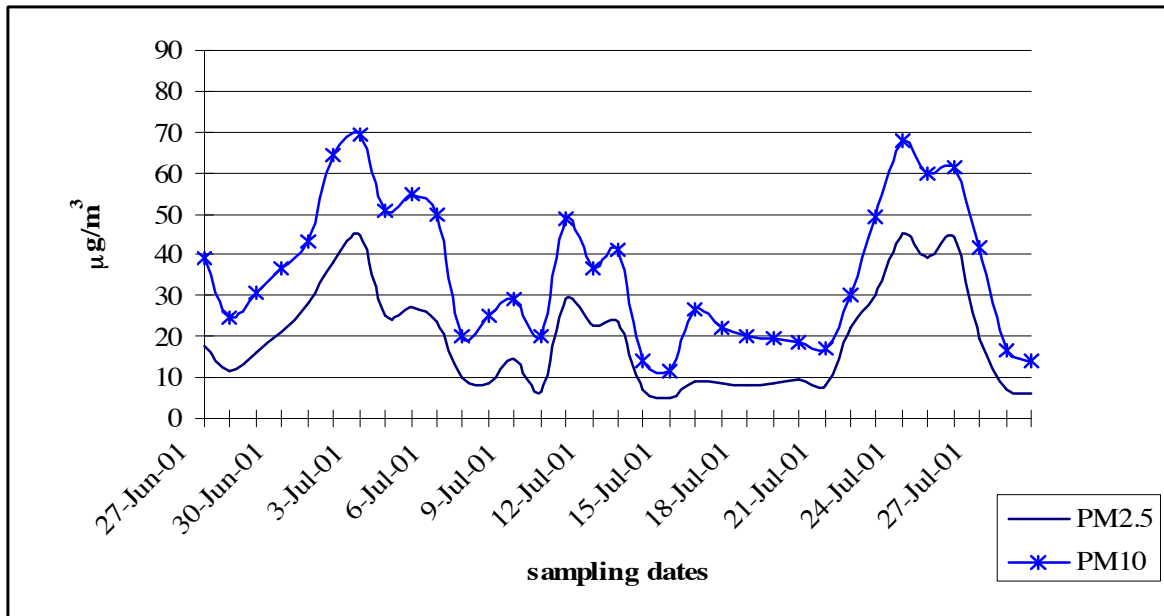


Figure 5. Comparison of PM₁₀ and PM_{2.5} concentrations at Francis Street site.

PM₁₀ COMPARISON TO OTHER SITES

The continuous particle, (TEOM PM₁₀) monitoring results for Francis Street, Yarraville were compared to two other EPA suburban monitoring stations located in Lord Street Richmond and Wingrove Street Alphington. These two EPA sites are located in suburban streets well away from main or arterial roads, although Lord Street is within the influence of City Link. The results for this comparison, presented in Figure 6, illustrate that the average PM₁₀ concentration at the Francis Street site was approximately 30 per cent to 40 per cent higher than the other two sites. The difference between Francis Street and the other two sites was statistically significant, whereas the difference between the Lord Street and Wingrove Street was not significant based on the statistical techniques, t-test and analysis of variance. This is, again, most likely indicative of the traffic density affecting the Francis St site.

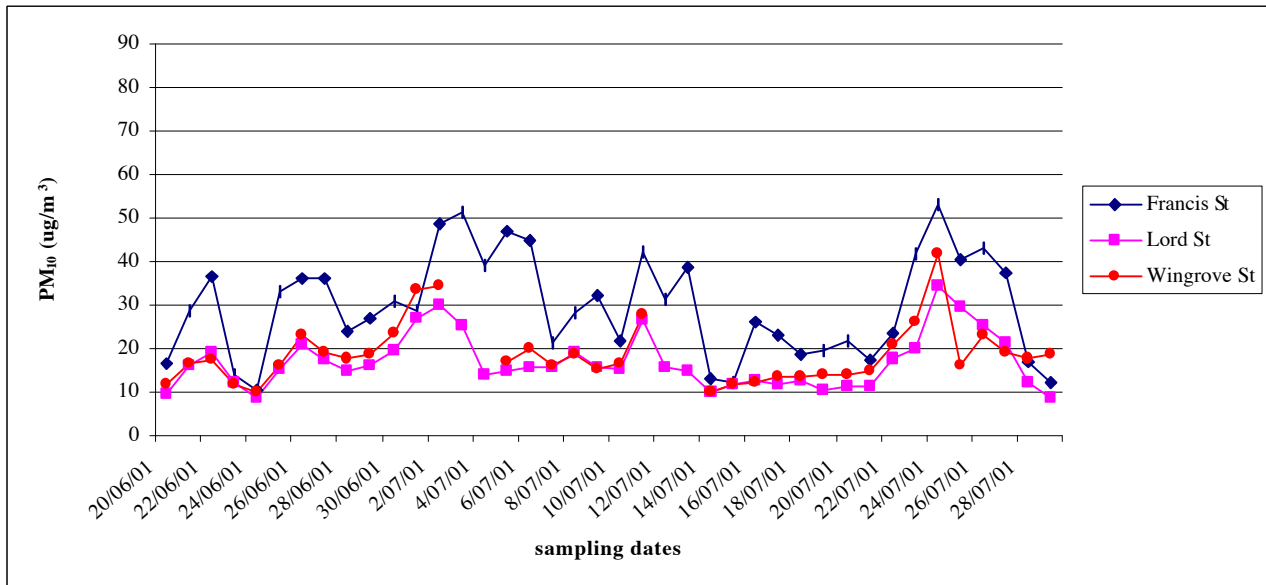


Figure 6. Comparison of Francis Street TEOM PM₁₀ monitoring results with two other EPA Victoria sites at Lord Street and Wingrove Street.

PM₁₀ monitoring data collected for 24 hours every six days during the year 2000 at EPA's particle roadside monitoring site, Hoddle Street, Collingwood (beside a main arterial road, the width of a service lane from the main carriageway) are presented in Figures 7 for comparison to Francis Street. The Collingwood site was chosen to represent typical PM₁₀ particle concentrations at a location beside a busy arterial road mainly used by petrol motor vehicles. Although the monitoring data are not strictly comparable because of the variation in the sampling interval and duration, and because the Hoddle Street site benefits from the presence of a service road between it and the major traffic flow, it can be used to provide indicative levels between the two sites.

Over the period of 12 months the PM₁₀ concentrations at Hoddle Street ranged from 6 µg/m³ to 47 µg/m³ and did not exceed the Intervention Level of 60 µg/m³. This indicates that the typical PM₁₀ concentrations at a location beside a major arterial road similar to Hoddle Street, Collingwood are generally lower than the site beside Francis Street, albeit recognising the differences in spatial arrangement at the two sites. Unlike Francis Street, the majority of vehicles using this arterial road are petrol powered and diesel vehicles do not make up a significant proportion of the traffic flow, suggesting the higher PM₁₀ at Francis Street is likely due to the emissions from diesel vehicles.

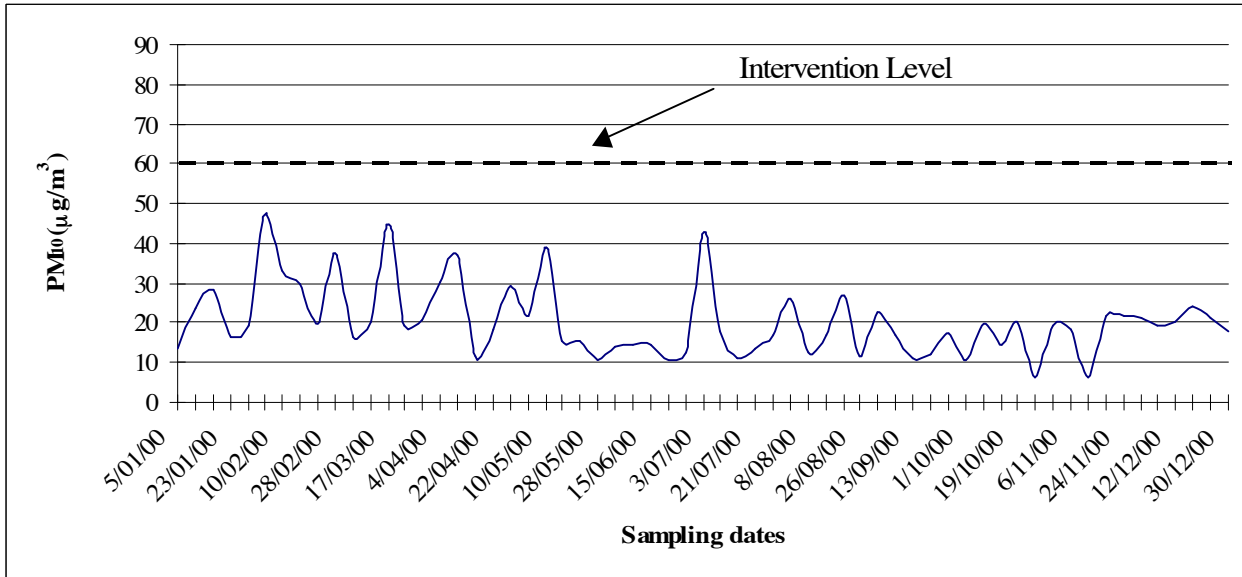


Figure 7. 24 hour average fine particle (PM₁₀) concentrations during 2000 at Hoddle Street Collingwood.

Nitrogen dioxide (NO₂)

The NO₂ concentrations measured ranged from 0.019 to 0.069 ppm. The highest one-hour nitrogen dioxide concentration measured as the maximum for one day was 0.069 ppm. This is well below the SEPP (AQM) Intervention Level of 0.140 ppm. The highest hourly nitrogen dioxide concentrations for each day are presented in Figure 8.

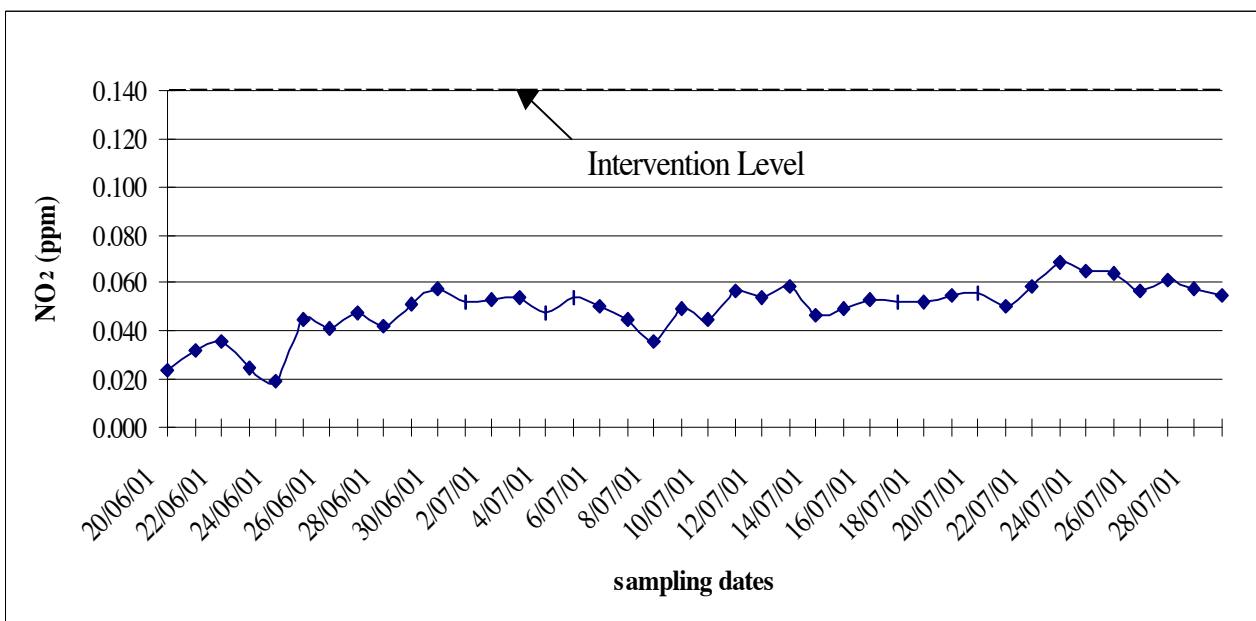


Figure 8. Maximum one hour NO₂ concentrations at Francis Street site.

CARBON MONOXIDE (CO)

The highest eight hour average concentration for CO, 4.5 ppm, was well below the SEPP (AQM) Intervention Level of 29 ppm for one hour. The maximum carbon monoxide concentration for each day ranged from 0.1 ppm to 4.5 ppm. These results are illustrated in Figure 9.

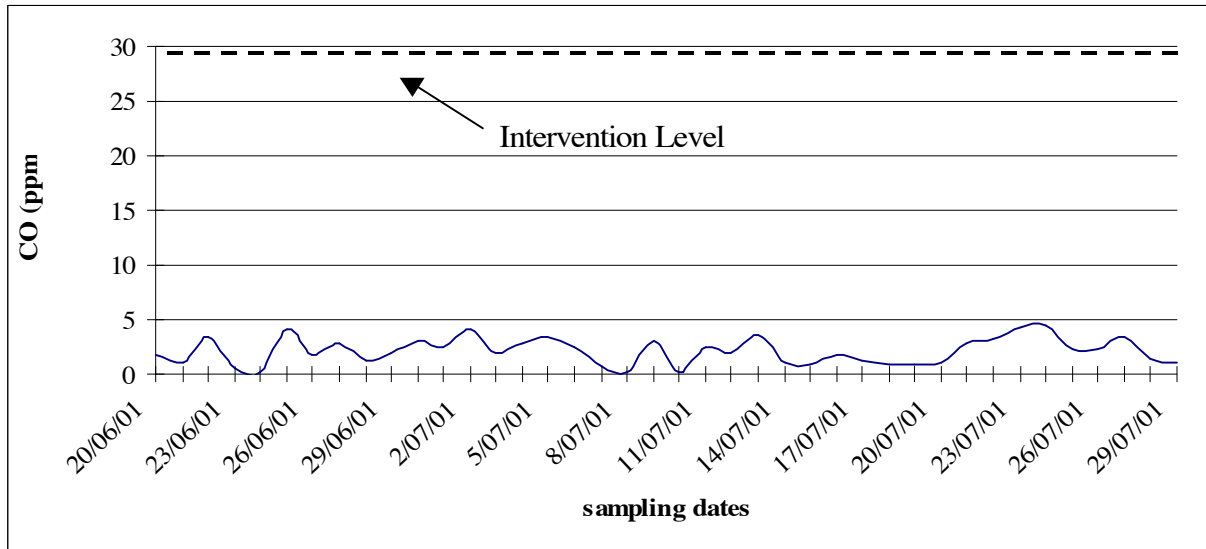


Figure 9. Maximum hourly CO average concentrations at Francis Street site.

Sulphur dioxide (SO₂)

The highest one hour, average SO₂ concentration was 0.023 ppm well below the SEPP (AQM) Intervention Level of 0.21 ppm for one hour. The highest hourly sulphur dioxide concentration measured is presented in Figure 10.

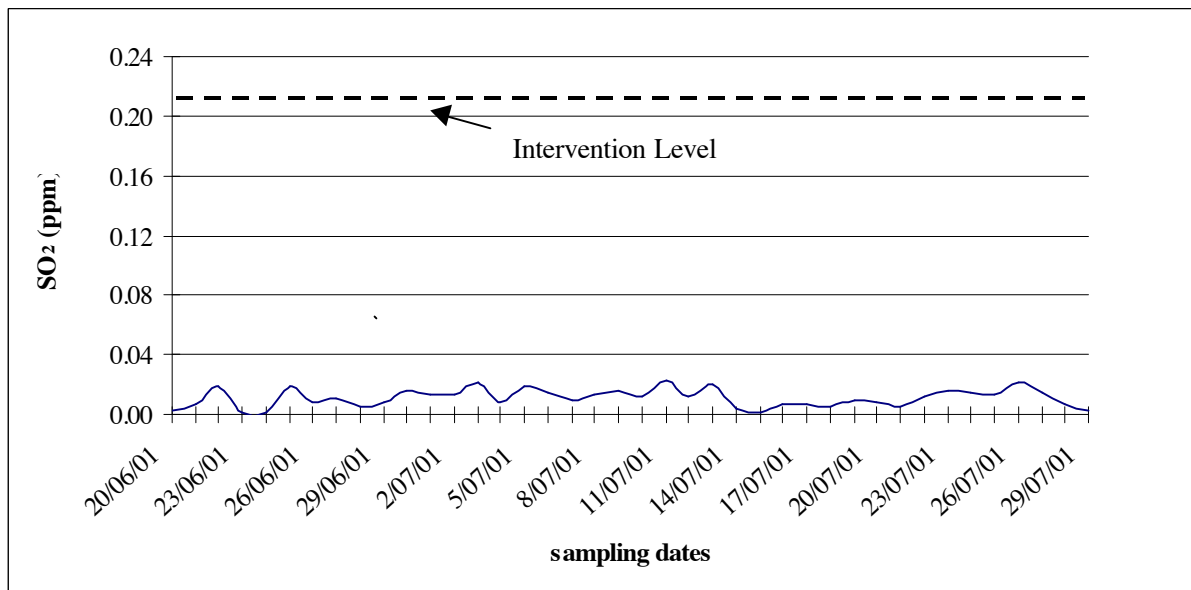


Figure 10. Daily maximum hourly average SO₂ concentrations at Francis Street site.

DISCUSSION

The monitoring results provide a baseline measurement of local air quality in Francis Street against which to measure the effectiveness of any management actions undertaken to improve local air quality. The data give an indication of the air quality at the roadside, and have been compared with Intervention Levels to protect human health at a local level.

The major observation was the exceedance of Intervention Levels for particles both PM_{10} and $PM_{2.5}$. The Intervention Levels are levels that, if exceeded, trigger action to further investigate and improve local air quality. For common pollutants, including particles, the Intervention Levels have been set at 20 per cent above the relevant ambient air quality objectives specified in the SEPP (AQM). These Intervention Levels are intended to indicate the risk carried across a community (ie. a local 'population'). An individual's risk from a given pollutant will depend on a number of factors including their susceptibility (eg. health, age) and exposure (eg. the time they spend at home and in their yards). In simple terms these levels of pollutants can result in an increased incidence of respiratory and cardiovascular related illnesses. The levels themselves, however, do not cause illness, but may exacerbate pre-existing illnesses.

While the airborne particles might originate from any of a number of combustion sources, the high traffic volumes at the site, and the lower concentrations on weekends, lead to the conclusion that motor vehicle traffic is the most likely major source.

EPA experience with pollutant sources such as roads is that pollutant levels quickly reduce with distance from the road. Levels reduce to approximately two thirds of near source levels within 50 metres and approximate ambient levels at 100 metres². This means any effect of elevated particle levels is expected to be limited to residences fronting Francis Street itself.

It is our judgement that the air quality in Francis Street, Yarraville represents an issue for environmental protection, especially given the comparison with another road carrying greater traffic load. However, complete comparisons are difficult, because of the limitations imposed by the available data, and there may well be other sites in Melbourne in the same situation.

CONCLUSION

- The SEPP (AQM) Intervention Levels for particles over a 24 hour averaging period was exceeded on four days for particles (PM_{10}) and five days for fine particles ($PM_{2.5}$) in July 2001. This indicates the air quality for particle concentrations was at a level of concern and may impact on the health of local residents on these days.
- The particle (PM_{10}) concentrations measured at the Francis Street site were significantly higher than the other EPA monitoring sites beside a major arterial road in Collingwood and in suburban areas of Alphington and Richmond.

² Freeway Air Quality Study: Westgate 1996-97. Environment Protection Authority. 1999.

- Levels of airborne particles might be expected to only affect the residences fronting Francis Street.
- The higher particle (PM_{10}) levels at Francis Street are likely due to the emissions from the large number of vehicles travelling along Francis Street, particularly diesel trucks.
- All measured nitrogen dioxide, carbon monoxide and sulphur dioxide concentrations were below the Intervention Levels suggested in the SEPP (AQM), and do not indicate local air quality problems for these pollutants.