



Air Quality in Quesnel

A Summary of Recent Trends in Levels of
Particulate Matter
September 2012

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QUESNEL AIR QUALITY ROUNDTABLE

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Executive Summary

This report provides a summary of recent trends in the levels of particulate matter (PM₁₀ and PM_{2.5}) in Quesnel. In order to evaluate the improvements in air quality as a result of the steps taken per the recommendations of the Airshed Management Plan (AMP) 2004-2014, we have excluded the impact of 2010 forest fires from our analysis.

Key points for 2011:

- The PM_{2.5} provincial objective for annual mean was met at all three continuous monitoring stations.
- The PM_{2.5} provincial objective for 24-hour mean was met at all three continuous monitoring stations.
- The PM_{2.5} airshed management plan goal was not met at the Maple Drive station.
- The number of PM₁₀ exceedances has increased in 2011 and 2012 at the Quesnel Senior Secondary (QSS) and Maple Drive stations.
- The PM₁₀ airshed management plan goal was not met at the QSS and Maple Drive stations.

Recommendations:

- Emission reduction from all sources during inversions.
- Improved strategies for dust control, including improved methods for application and removal of winter traction materials.

Summary of PM_{2.5} monitoring instrument upgrades:

- MoE is upgrading the PM_{2.5} monitoring equipment across the province.
- The new FEM (Federal Equivalent Method) instruments provide a more complete measurement of PM_{2.5} and may therefore record higher values than older instruments (TEOMs).
- The largest differences between FEM and TEOM measurements are expected in winter during cold periods when wood smoke is prevalent.

1 Introduction

The Ministry of Environment (MoE), in collaboration with stakeholders, maintains and operates the air quality and meteorological monitoring network in Quesnel, BC. As part of the Quesnel Air Quality Roundtable (hereafter referred to as the “roundtable”), MoE supports stakeholders to achieve the goals of the Quesnel Airshed Management Plan (QAMP). MoE provides regular updates to the roundtable on air quality trends and issues. The information included in this report was presented to the roundtable on June 6, 2012. This report evaluates the recent trends in PM_{2.5} and PM₁₀ within the framework of the Quesnel Airshed Management Plan 2004-2014 and Quesnel Airshed Management Plan Review- 2011.

PM_{2.5} (fine particulate matter or particulate matter with aerodynamic diameter less than 2.5 microns) is a pollutant of concern in Quesnel. Sources of PM_{2.5} include but are not limited to industries, wood stoves, motor vehicles and forest fires. Due to topography, Quesnel and many other interior communities in BC are susceptible to high levels of PM_{2.5} during inversions. PM_{2.5} has a broad range of adverse health effects, predominantly to the respiratory and cardiovascular systems. Research has not identified thresholds below which adverse effects do not occur. Both short-term and long-term exposures are associated with adverse health effects¹.

Another pollutant of concern in Quesnel is PM₁₀ (particulate matter with aerodynamic diameter less than 10 micron). Significant sources of PM₁₀ include winter traction material, dust from unpaved roads and unvegetated surfaces, and emissions from the wood processing industries. Generally, PM₁₀ exceedances occur during late winter/early spring when loose winter traction material becomes exposed on road surfaces. Measurements of PM₁₀ include PM_{2.5}; however, the main causes of PM₁₀ exceedances (24-hour average >50 micrograms/cubic meter) are not the same as the causes of PM_{2.5} exceedances (24-hour average > 25 micrograms/cubic meter).

2 Air Quality Monitoring Network

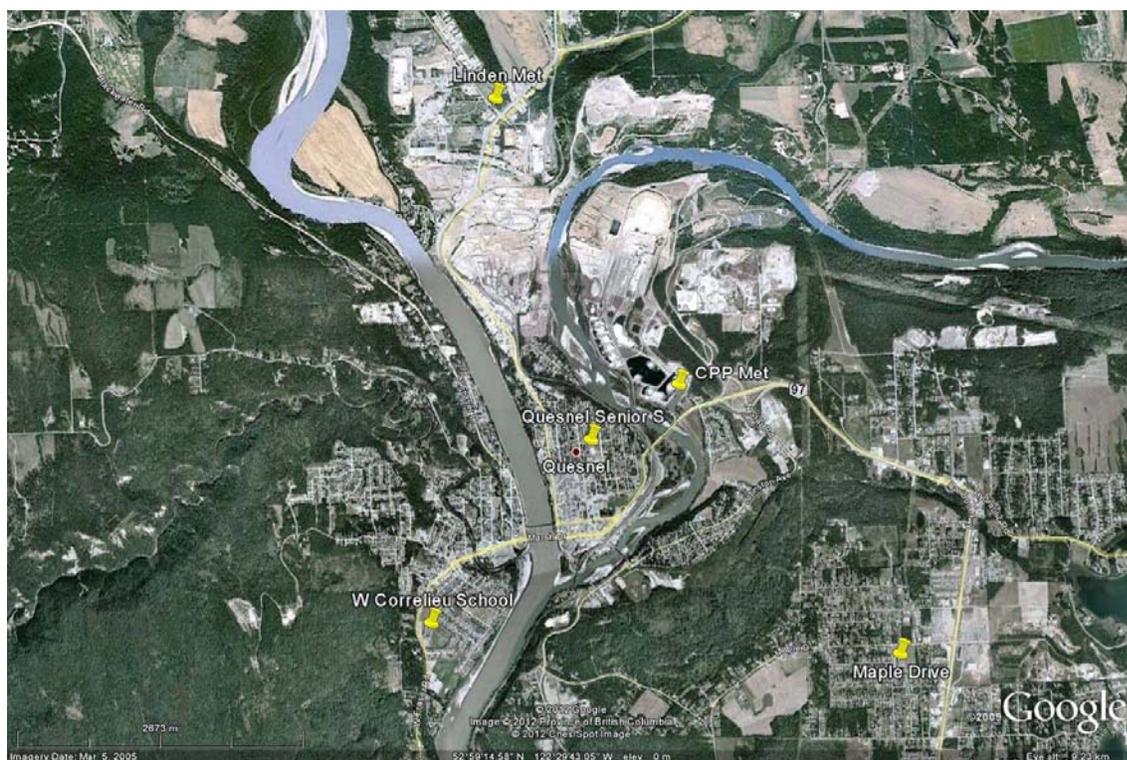
The MoE monitoring network in Quesnel includes three continuous monitoring stations located at Quesnel Senior Secondary (QSS), West Correlieu School and Maple Drive. At the QSS station, PM_{2.5}, PM₁₀, ozone, oxides of nitrogen and sulfur dioxide are continuously monitored. PM_{2.5} and PM₁₀ are continuously monitored at Maple Drive and West Correlieu stations. Additionally, sulphur (TRS) is measured at Maple Drive station. There are three meteorological stations in Quesnel, located at the QSS station, Cariboo Pulp & Paper and Linden. Real time data from all continuous monitoring stations are available at www.bcairquality.ca. Figure 1 shows a map of the monitoring network.

¹ WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide. Global update 2005. Summary of risk assessment. WHO/SDE/PHE/OEH/06.02

2.1 Data Completeness Criteria

Valid data must be available for at least 75% of the scheduled days in each quarter of a calendar year to satisfy data completeness criteria. At least 18 hourly measurements are required to calculate a valid 24-hour average (midnight to midnight). Missing data generally result from instrument failure. If a significant fraction of data is missing in a given year, a bias in annual statistics is possible. Stations that do not meet data completeness criteria have been flagged in this report.

Figure 1: Air quality and meteorological monitoring stations in Quesnel



3 Recent Trends

This section includes a summary of recent trends in the levels of ambient $PM_{2.5}$ and PM_{10} . Other pollutants have been consistently below the provincial objectives and are therefore not discussed in this report.

3.1 $PM_{2.5}$

There are two provincial objectives for $PM_{2.5}$ - a 24-hour objective and an annual objective. The Quesnel Air Quality Roundtable has also set an airshed management plan goal for $PM_{2.5}$ (Table 1). The airshed management plan goals are based on the three year moving average of 98th

percentile values. Thus, the forest fires of 2010 will influence this statistic in 2010, 2011 and 2012. Additionally, if we include PM_{2.5} data that coincide with the occurrence of 2010 forest fires, it will confound the trends and will not allow an accurate evaluation of progress made as a result of the airshed planning process. In order to understand the trends, we have excluded the time period of 2010 forest fires from our analysis. This in no way implies that the data collected during the 2010 forest fires are faulty or the forest fires had no impact on air quality. However, the objective is to understand the progress made as a result of the airshed planning process in Quesnel by removing the influence of an extreme and rare natural event that will confound the trends.

Table 1: PM_{2.5} Provincial Objectives and Airshed Management Plan Goals

PM_{2.5} Objective/Goal Type	PM_{2.5} Objective/Goal (µg/m³)
24-hour Objective (Provincial)	25 ¹
Annual Objective (Provincial)	8
Airshed Management Plan Goal	18 ²
¹ Based on 98 th percentile	
² Based on 3-year moving average of 98 th percentile	

The concentrations of air pollutants vary both temporally and spatially. The spatial variation is due to a combination of a number of factors like proximity to sources, wind patterns, land use, terrain, etc. In order to understand spatial patterns, we discuss each monitoring station separately.

3.1.1 PM_{2.5} at Quesnel Senior Secondary (QSS) Station

The trends at the QSS station (Figure 2) show that the provincial objectives were met in 2011. If we exclude the 2010 forest fires (Figure 3), we can see a slight decreasing trend in the 98th percentile values. The annual mean and 98th percentile values would have met the respective provincial objectives in 2010 if we exclude 2010 forest fires from our analysis.

Figure 2: PM_{2.5} trends at the QSS station, including 2010 forest fires

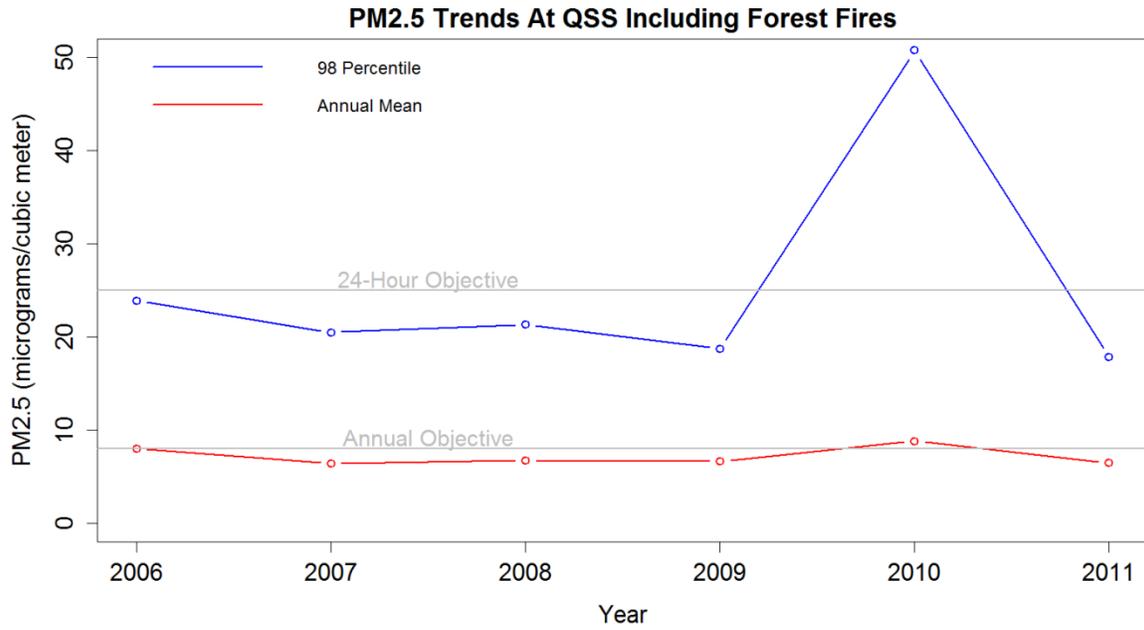
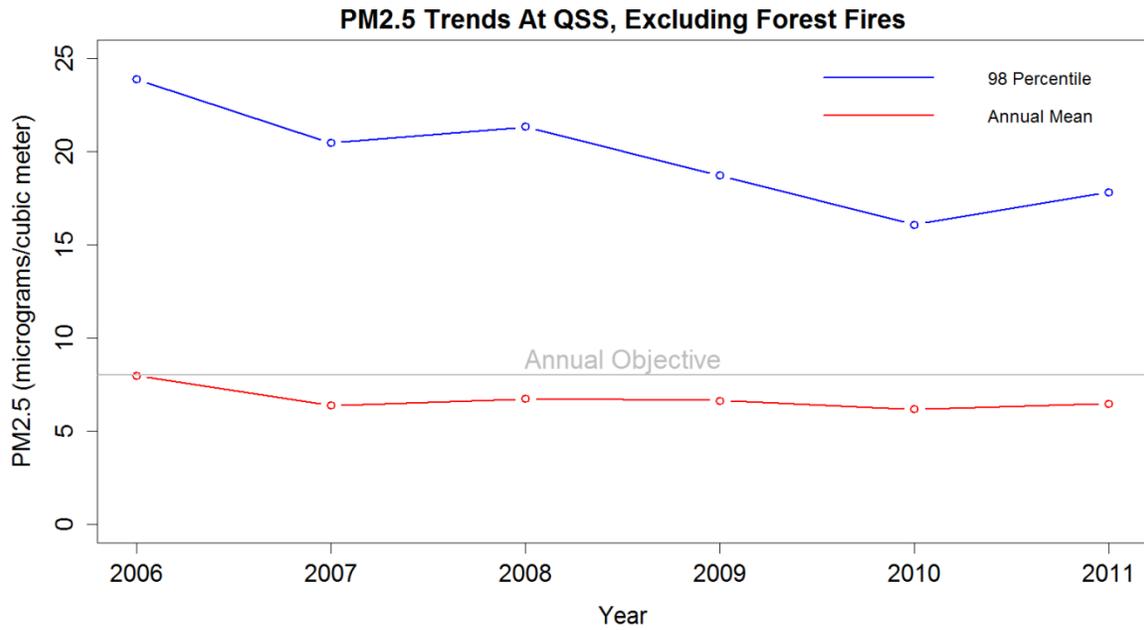
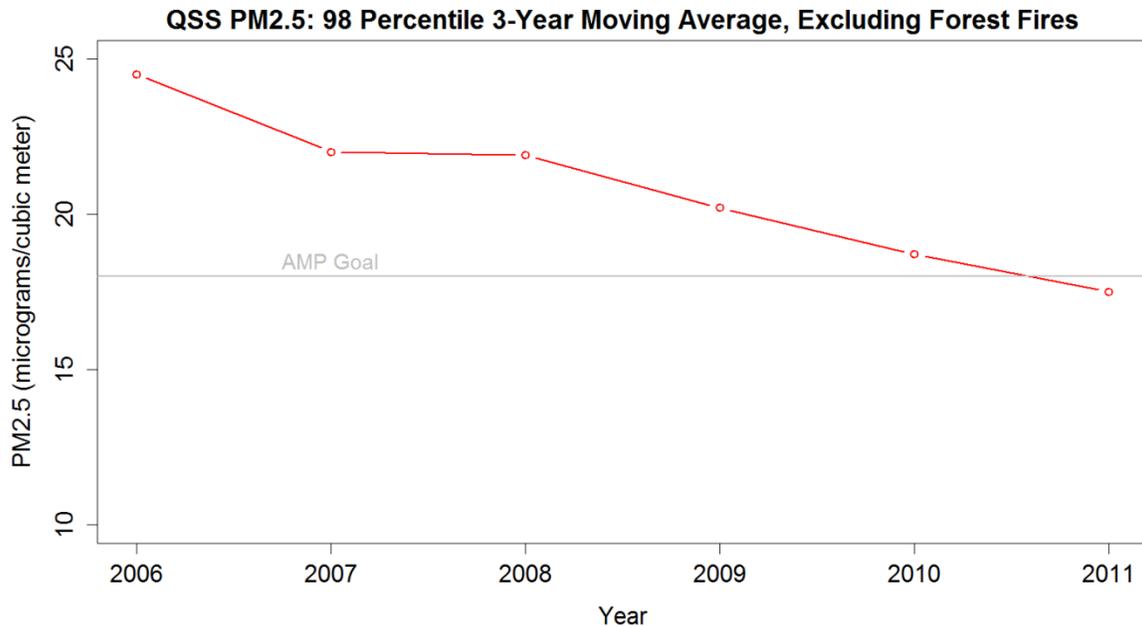


Figure 3: PM_{2.5} trends at the QSS station, excluding 2010 forest fires



If we exclude 2010 forest fires from analysis, the airshed management plan goal for PM_{2.5} would have been met at the QSS in 2011 (Figure 4). We can also see a decreasing trend in the three year moving average of the 98th percentile if we exclude the 2010 forest fires from analysis.

Figure 4: PM_{2.5} 98th percentile 3-year moving average at the QSS station, excluding 2010 forest fires



3.1.2 PM_{2.5} at the West Correlieu (COR) Station

The West Correlieu station shows the lowest levels of PM_{2.5} amongst the three continuous monitoring stations in Quesnel. Trends at this station (Figure 5) show that both the provincial objectives were met in 2011 and that there is a slight decreasing trend in the 98th percentile values. If we exclude the 2010 forest fires, the airshed management plan goal (Figure 6) would have been met in 2011 and we can see a decreasing trend in the three year moving average of 98th percentile value.

Data completeness criteria were not satisfied at the West Correlieu station in 2011. However, we do not expect a significant bias in annual statistics due to missing data in 2011.

Figure 5: PM_{2.5} trends at the West Correlieu station, excluding 2010 forest fires

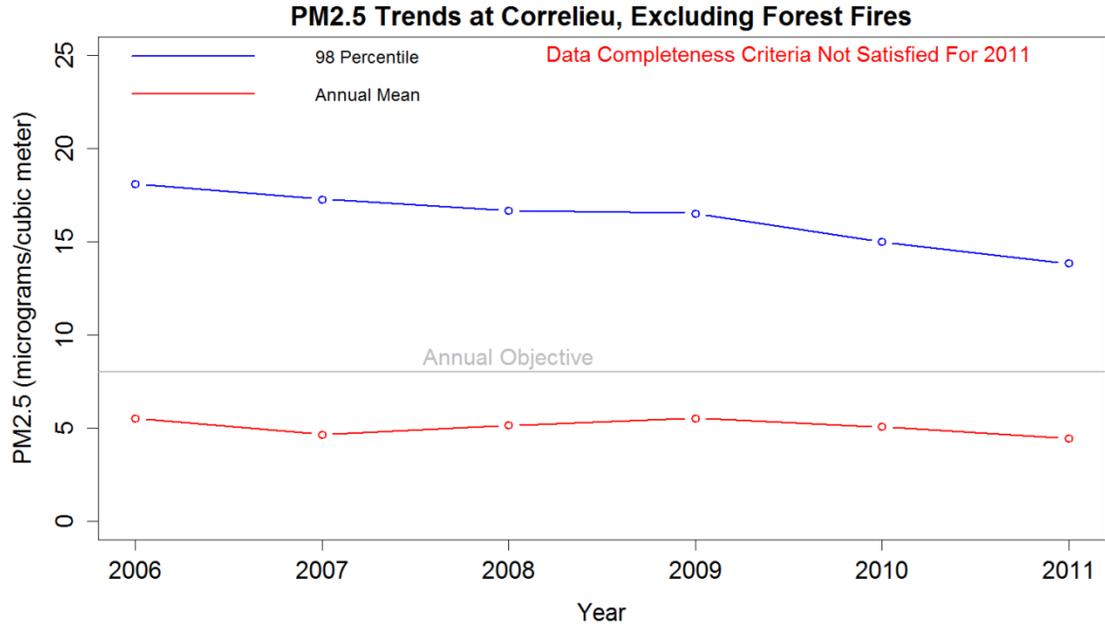
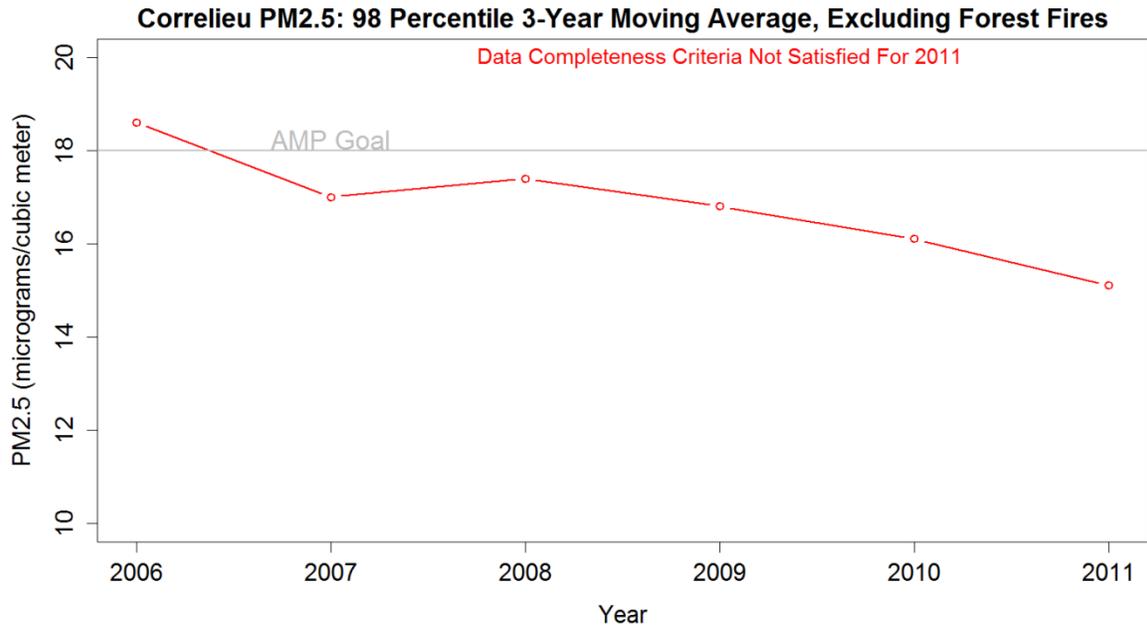


Figure 6: PM_{2.5} 98th percentile 3-year moving average at the West Correlieu station, excluding 2010 forest fires



3.1.3 PM_{2.5} at the Maple Drive (MDR) Station

The PM_{2.5} trends at the Maple Drive station show that both provincial objectives were met at the station in the year 2011. If we exclude 2010 forest fires from the analysis, there is a slight decrease in the annual mean and the 98th percentile in 2010 and 2011. The airshed management plan goal for PM_{2.5} has not been met at the Maple drive station yet. This is due to the fact that high levels of PM_{2.5} continue to impact this site during winter time inversions. MoE plans to conduct further analysis using dispersion modelling to better understand PM_{2.5} episodes at this site.

Figure 7: PM_{2.5} trends at the Maple Drive station, excluding forest 2010 fires

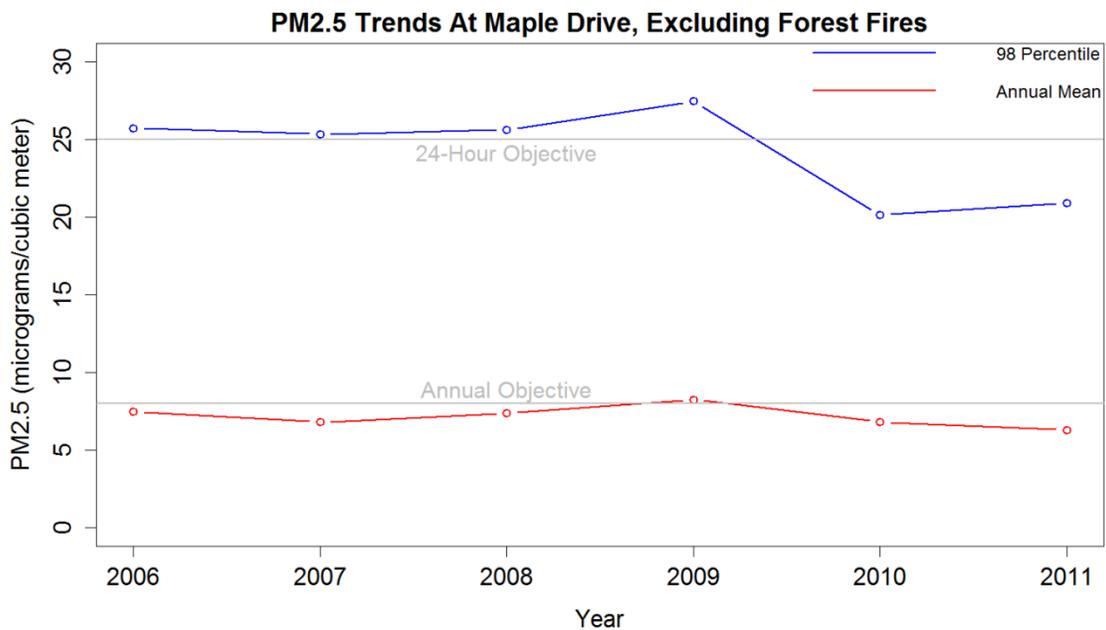
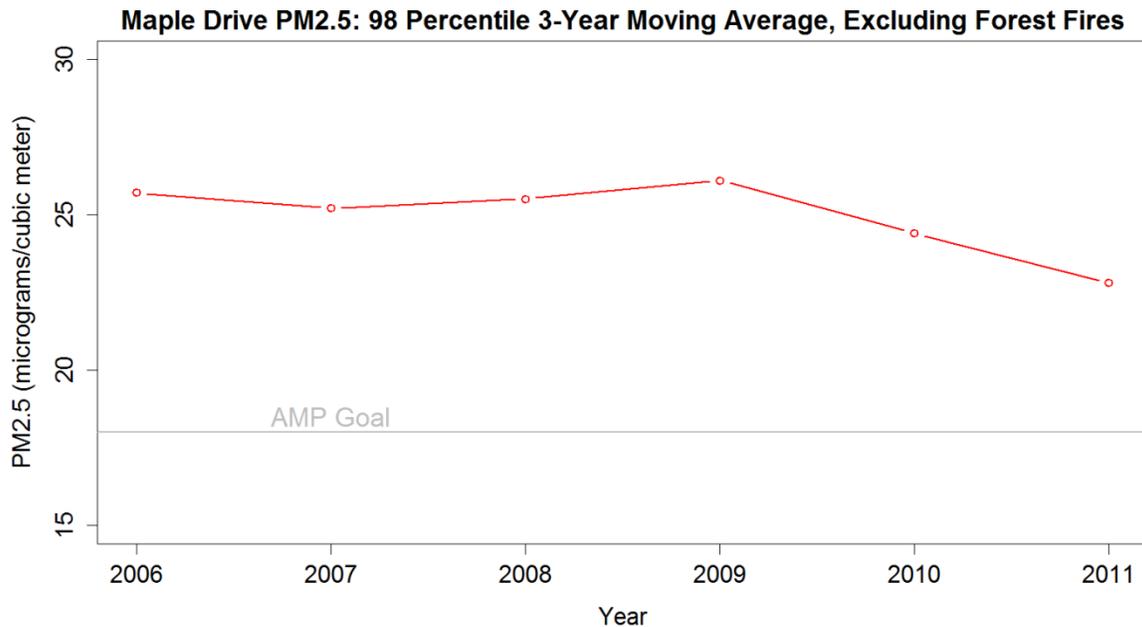


Figure 8: PM_{2.5} 98th percentile 3-year moving average at the Maple Drive station, excluding 2010 forest fires



3.2 PM₁₀

3.2.1 PM₁₀ at the QSS station

The QAMP includes a number of recommendations to alleviate the dust issues in Quesnel. At the QSS station the 98th percentile value increased in 2011 compared to 2009 (Figure 9). Further, the annual mean at the QSS station has not shown any significant change in the recent years. It must be noted that data completeness criteria were not satisfied for 2009, 2010 and 2011 for PM₁₀ at the QSS station. We do not expect the missing data in 2009 and 2011 to significantly bias the annual statistics. The annual mean and the 98th percentile value were not calculated for the year 2010 at this station due to completely missing data due to instrument failure. The AMP goal for PM₁₀ was not met at the QSS station in 2011.

Figure 9: PM₁₀ trends at the QSS station

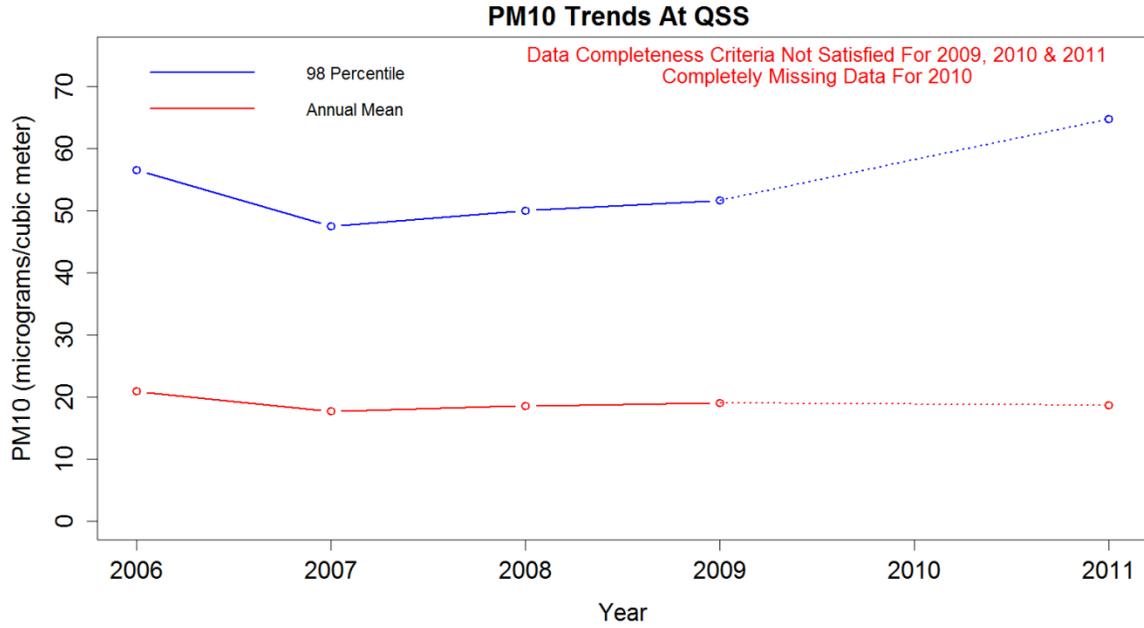
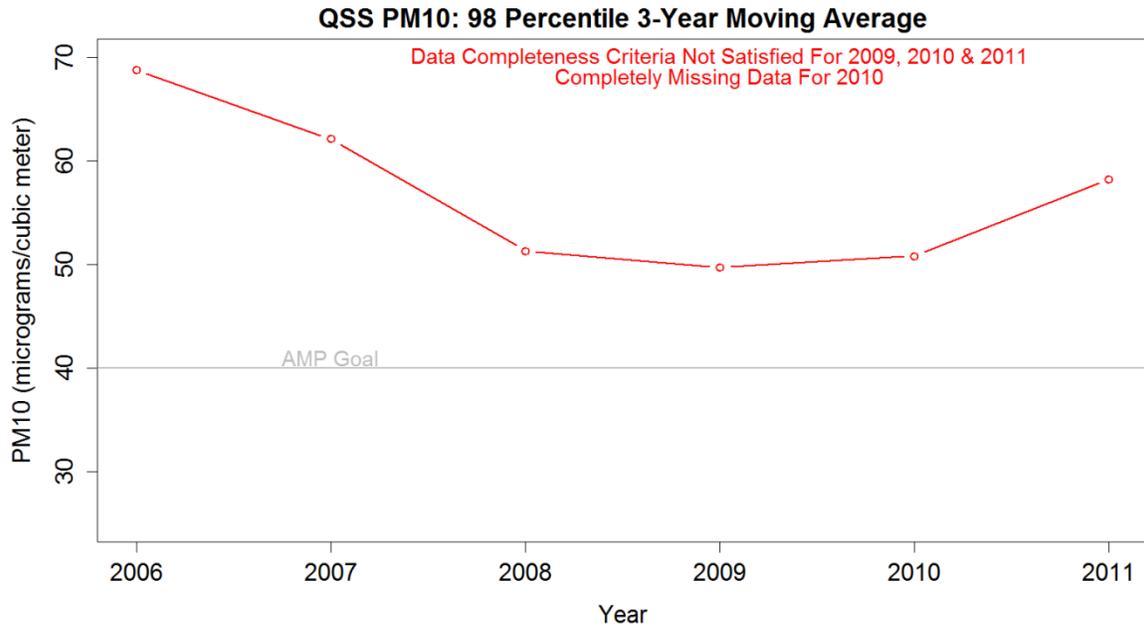


Figure 10: PM₁₀ 98th percentile 3-year moving average at the QSS station



3.2.2 PM₁₀ at the West Correlieu (COR) Station

The PM₁₀ levels at the West Correlieu station (Figure 11) have been fairly stable over past 5 years and are lower in comparison to the QSS and Maple Drive stations. Data completeness criteria were not satisfied at the West Correlieu station in 2011. However, we do not expect the missing data in 2011 to significantly bias the annual statistics. The airshed management plan goal for PM₁₀ was met in 2011 and there is a slight decreasing trend (Figure 12) in the three year moving average of the 98th percentile.

Figure 11: PM₁₀ trends at the West Correlieu station, excluding 2010 forest fires

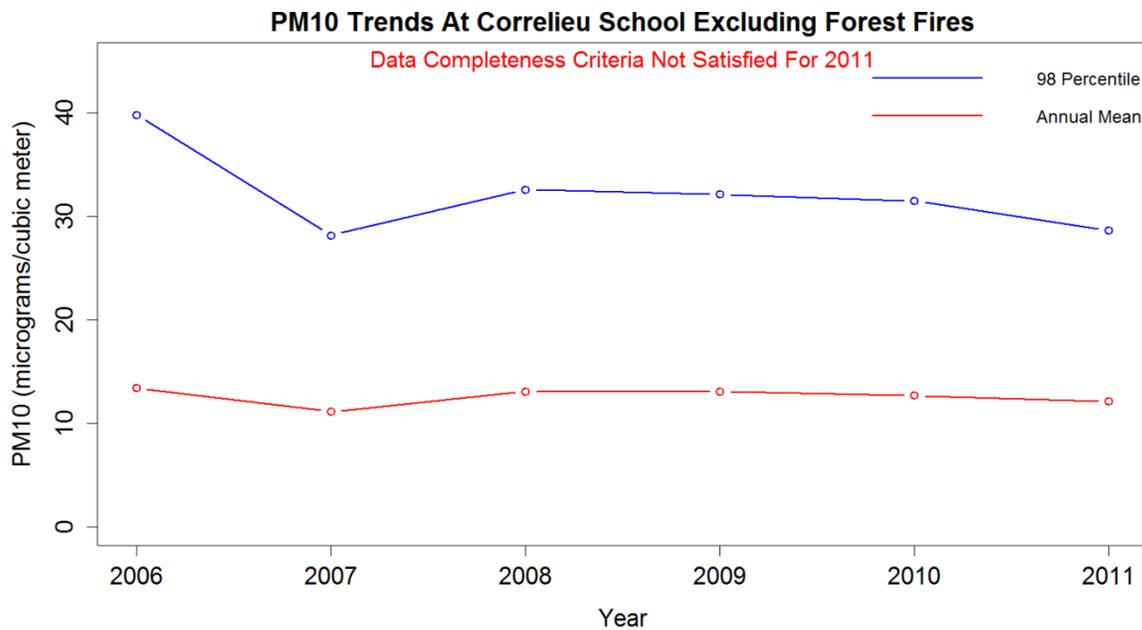
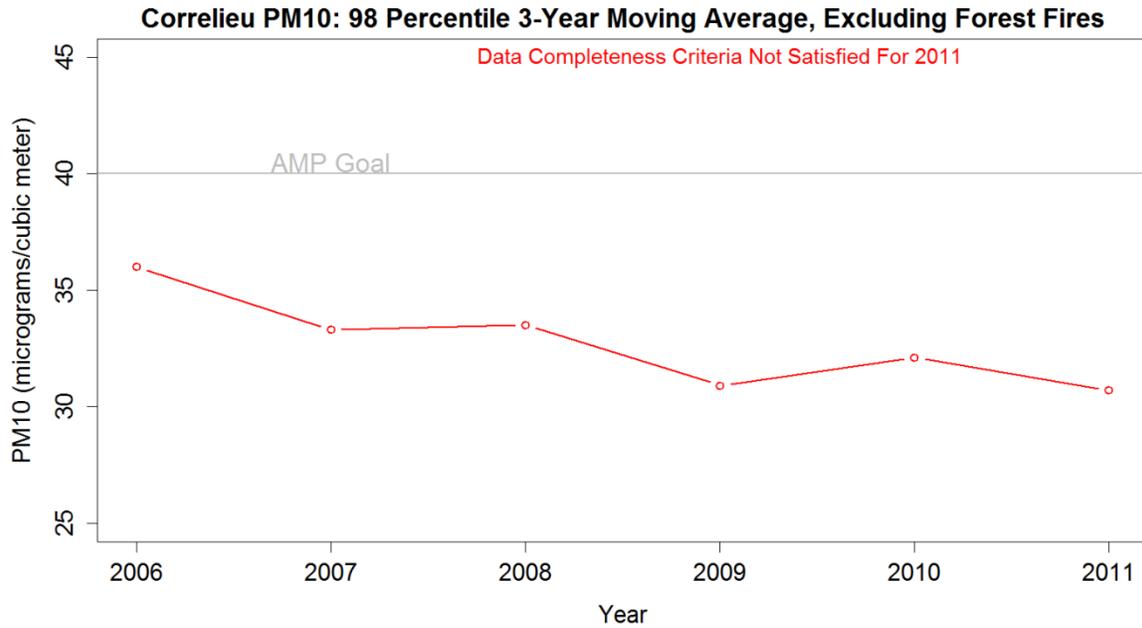


Figure 12: PM₁₀ 98th percentile 3-year moving average at the West Correlieu Station, excluding 2010 forest fires



3.2.3 PM₁₀ at the Maple Drive (MDR) Station

There is a slight increase in the levels of PM₁₀ at the Maple Drive since 2010. The airshed management plan goal for PM₁₀ was not met in 2011. A significant increase in the 98th-percentile was observed for 2011. This is indicative of the increasingly higher levels of PM₁₀ during dust episodes. The trends in PM₁₀ point to the increased importance of improved dust control strategies, including improved methods for application and removal of winter traction material.

Figure 13: PM₁₀ trends at the Maple Drive station, excluding 2010 forest fires

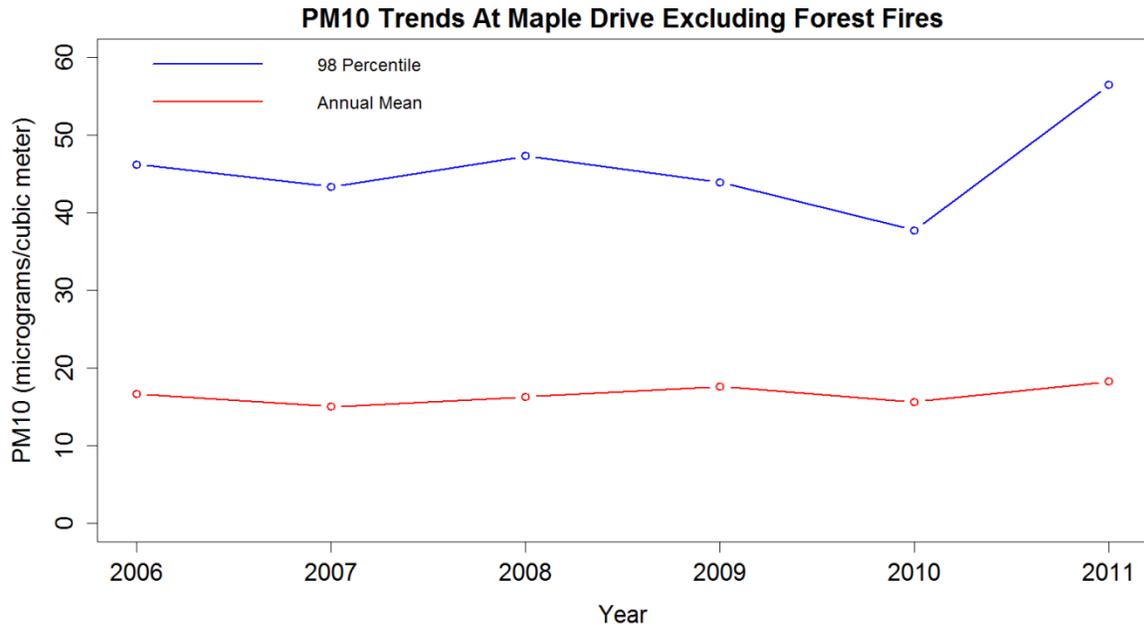
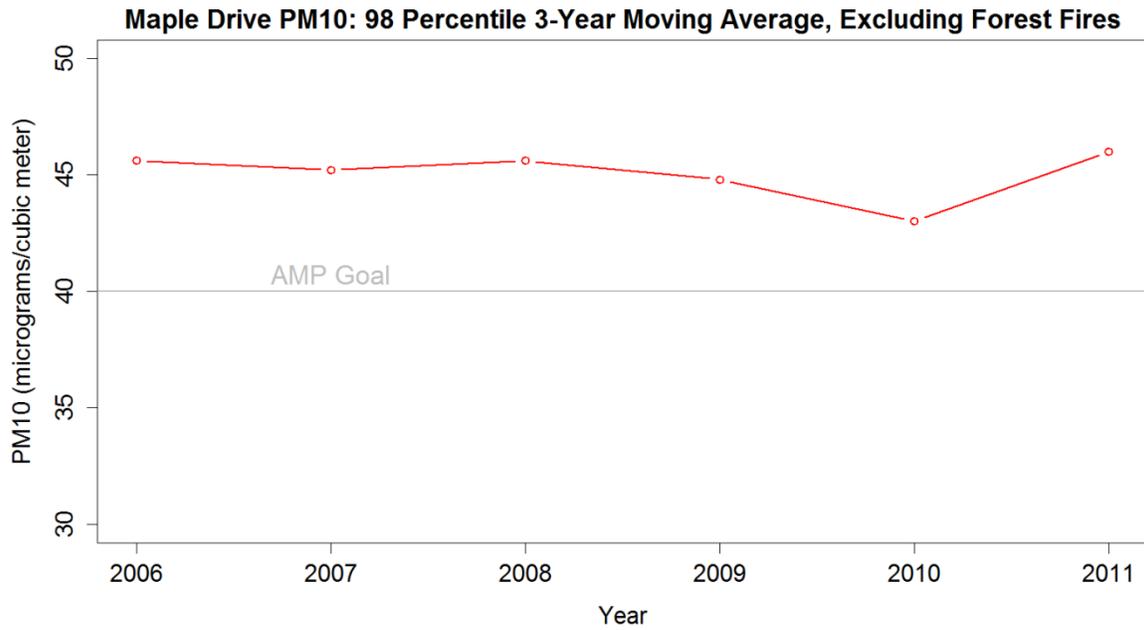


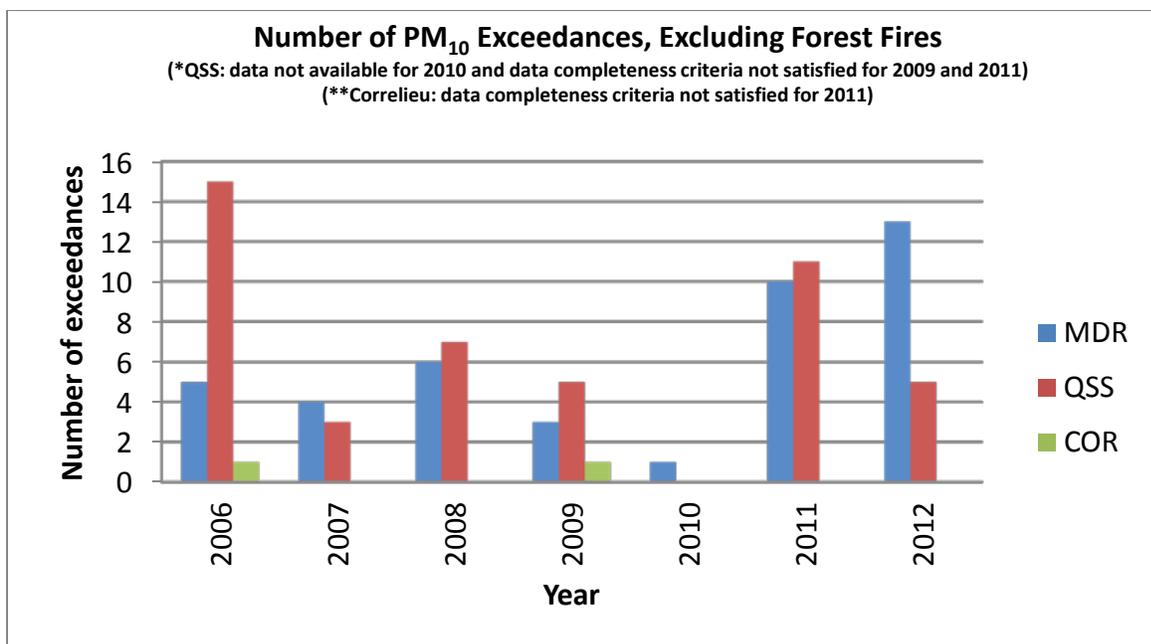
Figure 14: PM₁₀ 98th percentile 3-year moving average at the Maple Drive station, excluding 2010 forest fires



3.2.4 PM₁₀ Exceedances

The provincial objective for PM₁₀ is 50 micrograms/cubic meter (24-hour average). There has been an increase in the number of PM₁₀ exceedances at the Maple Drive and QSS stations in 2011 and 2012 (Figure 15). Please note that PM₁₀ data were not available at the QSS station for 2010 and data completeness criteria were not satisfied for 2009 and 2011. Also, data completeness criteria were not satisfied at the West Correlieu station in 2011. Data from first quarter of 2012 have also been included to illustrate the increase in number of exceedances at the Maple drive station.

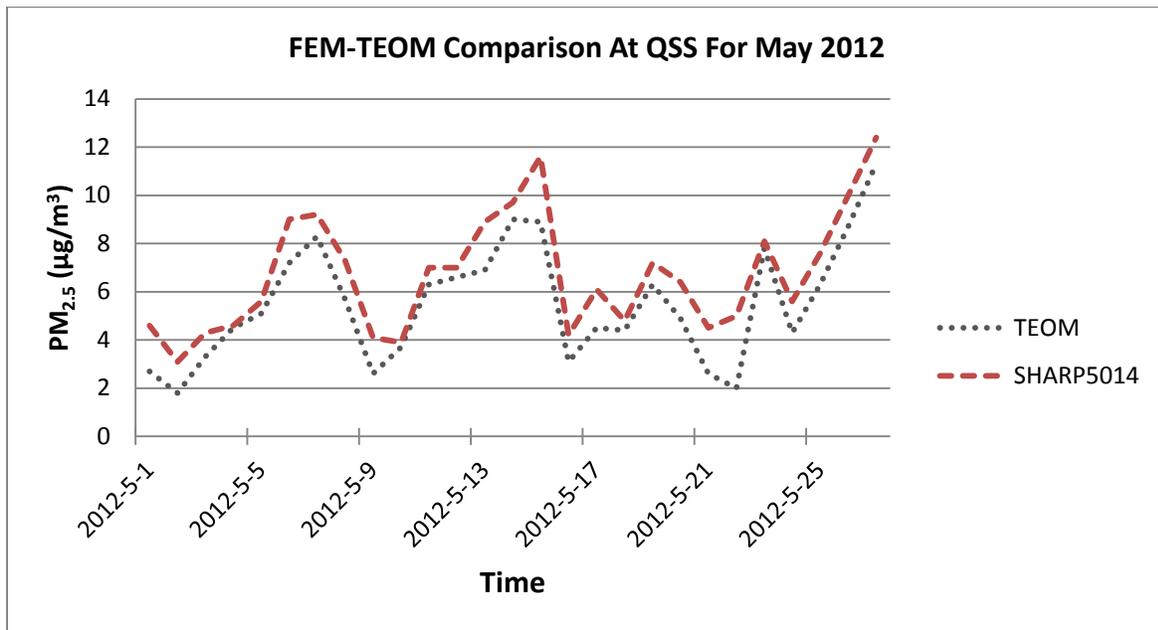
Figure 15: Number of PM₁₀ exceedances in Quesnel, excluding 2010 forest fires



4 PM_{2.5} Monitoring Upgrades

MoE is upgrading the PM_{2.5} monitoring network across the province. The upgrades have been completed at the QSS station. The new FEM (Federal Equivalent Method) instruments provide more complete measurements of PM_{2.5} and potentially higher readings. The difference between PM_{2.5} measurements obtained using TEOM (current technology) and FEM equipment varies seasonally, with the largest differences expected in the winter when temperatures are cold and wood smoke is prevalent. The smallest differences are anticipated during the summer (Figure 16). These differences will be better understood with ongoing collection of more data.

Figure 16: PM_{2.5} FEM (SHARP) -TEOM comparison for May 2012 at the QSS station in Quesnel



5 Conclusions

Since most PM_{2.5} exceedances occur during periods of inversion, MoE plans to provide advance warning to stakeholders in Quesnel before periods of inversions during winter. Such forecasts have their limitations but can allow stakeholders to reduce PM_{2.5} emissions wherever possible. Other emission reduction actions, such as switching to cleaner fuels for space heating during periods of inversion, will also alleviate levels PM_{2.5}.

There has been an increase in the number of PM₁₀ exceedances at the QSS and Maple Drive stations in 2011 and 2012. Improved dust control measures, including improved methods for application and removal of winter traction material will help alleviate the problem.