BRITISH COLUMBIA | Ministry of Environment and Climate Change Strategy

# Air Quality in Kamloops

Handout to accompany 2017 update to Kamloops Air Quality Round-table

Presented 18th July, 2018

Prepared by: Ralph Adams
Environmental Protection Division
Monitoring, Assessment and Stewardship
Kamloops
(250-371-6279) ralph.adams@gov.bc.ca

## Data used in this summary

This summary is based on air quality measurements which are available at the Ministry air quality site www.bcairquality.ca. The data used in preparing this summary were downloaded on May 14th, 2018. The analysis and document preparation were done using the R statistical package. The scripts used to generate the analysis and this handout are available on request.

The complete record of $PM_{2.5}$ measurements available for Kamloops were used in the preparation of this summary. This means that both the older TEOM instruments, and the newer FEM (in this case both a Sharp 5030 and a BAM 1020) were used in the calculations. The FEM instrument became operational in 2010, with the first full year of data in 2011. The older TEOM instruments are known to underestimate $PM_{2.5}$, especially under cold winter conditions. This must be kept in mind when interpreting these data.

These data were measured at the Ministry Air Quality stations located at the old Mayfair City Works yard and the Federal Building downtown. Data from the Upper Aberdeen air station, which was in operation until January 2017, have not been included in this summary.

# SUMMARY

- The wildfires of 2017 had a major impact on air quality in Kamloops. Both the magnitude and duration of elevated levels were unprecedented. Similar impacts were seen in many interior communities, e.g. Williams Lake and Quesnel. In all these communities annual statistics exceeded ambient air quality objectives in 2017.
- When the effects of the wildfires are removed from the data, there is little indication of a trend in $PM_{2.5}$ statistics in Kamlooops since the FEM instruments became operational. When wildfire effects are removed, Kamloops meets all ambient air quality objectives except the Provincial annual objective for $PM_{2.5}$. This objective was not met in 2013, 2014 and 2015. The objective was met in 2011, 2012, 2016 and 2017.
- Available data from: the Upper Aberdeen station, historical Partisol data from numerous locations in Kamloops, and the network of Purple Air monitors installed by residents, all indicate that the values measured at the Federal building are representative of the highest values, and, as expected, overall air quality improves with elevation.

| Contaminant | Avg. Period | Air Quality Objective | Source | Date |
|---|---|---|---|---|
| $PM_{2.5}$ | annual | 8[1] | BCAQO | 2009 |
| | | 10[2] | CAAQS | 2013 |
| | 24 hr. | 25[3] | BCAQO | 2009 |
| | | 28[4] | CAAQS | 2013 |

Table 1: Ambient air quality objectives that are used in the Kamloops Airshed. Objectives include Canadian Objectives (CAAQS) and BC Objectives (BCAQO).

[1]Achievement based on annual average, over one year.
[2]Achievement based on annual average, averaged over three consecutive years.
[3]Achievement based on 98th percentile of daily averages, over one year.
[4]Achievement based on 98th percentile of daily averages, averaged over three consecutive years.

| year | annual | | annual (3yr) | | 24 hour | | 24 hour (3yr) | |
|---|---|---|---|---|---|---|---|---|
| | Mayfair | Federal | Mayfair | Federal | Mayfair | Federal | Mayfair | Federal |
| | (all units in $\mu gm^{-3}$) | | | | | | | |
| 1998 | 5.7 | | | | 16 | | | |
| 1999 | 4.6 | | 5.1 | | 13 | | 14 | |
| 2000 | 5.6 | | 5.3 | | 15 | | 14 | |
| 2001 | 5.3 | | 5.2 | | 13 | | 14 | |
| 2002 | 6.7 | | 5.9 | | 20 | | 16 | |
| 2003 | 7.9 | | 6.6 | | 41 | | 25 | |
| 2004 | 5.7 | | 6.8 | | 17 | | 26 | |
| 2005 | 4.7 | | 6.1 | | 13 | | 24 | |
| 2006 | 5.0 | | 5.1 | | 16 | | 15 | |
| 2007 | 4.9 | | 4.9 | | 14 | | 14 | |
| 2008 | 5.1 | | 5.0 | | 14 | | 15 | |
| 2009 | 5.7 | | 5.2 | | 24 | | 17 | |
| 2010 | 5.4 | | 5.4 | | 32 | | 23 | |
| 2011 | | 7.7 | 5.5 | | | 18 | 28 | |
| 2012 | | 7.9 | | 7.8 | | 19 | | 19 |
| 2013 | | 8.9 | | 8.2 | | 21 | | 20 |
| 2014 | | 9.0 | | 8.6 | | 28 | | 23 |
| 2015 | | 8.5 | | 8.8 | | 21 | | 24 |
| 2016 | | 7.8 | | 8.5 | | 16 | | 22 |
| 2017 | | 15.3 | | 10.6 | | 128 | | 55 |

Table 2: $PM_{2.5}$ statistics at the Mayfair Street and Federal Building air stations from 1998 until 2017. Values based on both the older TEOM and newer FEM instruments are shown. The statistics shown are those used in the objectives used in table 1: the annual average, the three year running average, the 98th percentile of the daily averages, and the three year running average of the 98th percentile of the daily averages. The TEOM instruments are known to underestimate $PM_{2.5}$ concentrations, particularly in cold winter conditions. The increase in both annual average and the 98th percentile of the daily averages when the FEM instruments are used is clear.

| year | annual | | 24 hour | |
|---|---|---|---|---|
| | fires included | fires removed | fires included | fires removed |
| | (all units in $\mu gm^{-3}$) | | | |
| 2011 | 7.7 | 7.7 | 18 | 18 |
| 2012 | 7.9 | 7.9 | 19 | 19 |
| 2013 | 8.9 | 8.9 | 21 | 21 |
| 2014 | 9.0 | 8.7 | 28 | 24 |
| 2015 | 8.5 | 8.1 | 21 | 20 |
| 2016 | 7.8 | 7.8 | 16 | 16 |
| 2017 | 15.3 | 7.2 | 128 | 21 |

Table 3: $PM_{2.5}$ statistics at the Federal Building air station from 2011 until 2017. These values are based only on newer FEM instruments, the first full year of FEM derived data at the Federal air station was 2011. For each year, and for both the annual average and the 98th percentile of the daily average, statistics with and without fires removed are shown. The technique used to remove the effects of wildfires was to replace daily averages during the summer forest fire season (July, August and September), that exceeded $28\,\mu gm^{-3}$ with the average values for the same day based on years where fires did not have a significant effect on $PM_{2.5}$ levels. For each day replaced, the average for that day in 2011, 2013 and 2016 was used.

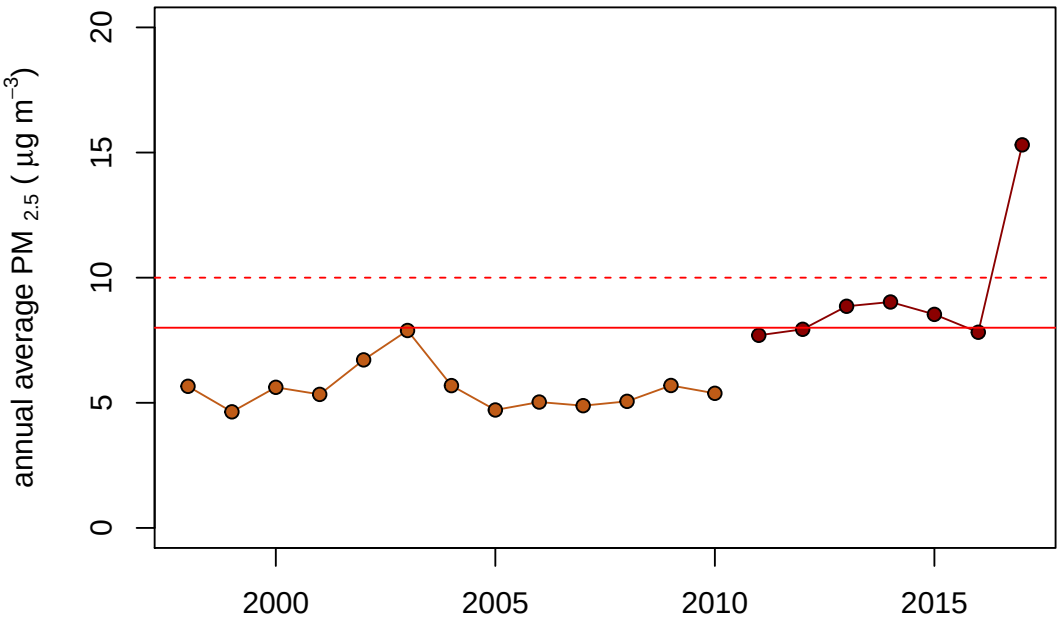


Figure 1: Trend in annual average $PM_{2.5}$ concentrations at the Mayfair (TEOM) and Federal (FEM) air stations. Values from the older TEOM instruments are shown in orange, those from the newer FEM instruments in red. The increase in measured values between the TEOM and FEM instruments is clear. The solid red line indicates the provincial BCAQO of 8 $\mu gm^{-3}$ and the dashed red line indicates the Canadian CAAQO of 10 $\mu gm^{-3}$. The effects of fires have not been removed from the data used to calculate these statistics. The effect of wildfires in 2017 is clear.

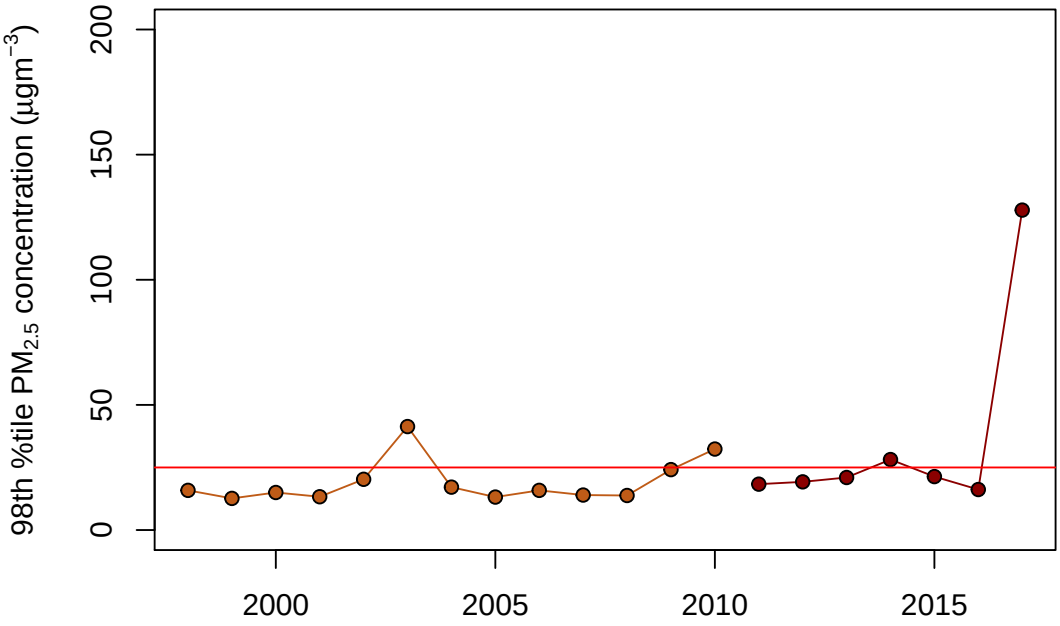


Figure 2: Trend in the 98th percentile of daily average $PM_{2.5}$ concentrations at the Mayfair and Federal air stations. Values from the older TEOM instruments are shown in orange, those from the newer FEM instruments in red. The increase in measured values between the TEOM and FEM instruments is clear. The solid red line indicates the provincial BCAQO of 25 $\mu gm^{-3}$. The effects of fires have not been removed from the data used to calculate these statistics. The effect of the wildfires in 2003, 2010, 2014 and 2017 are visible.

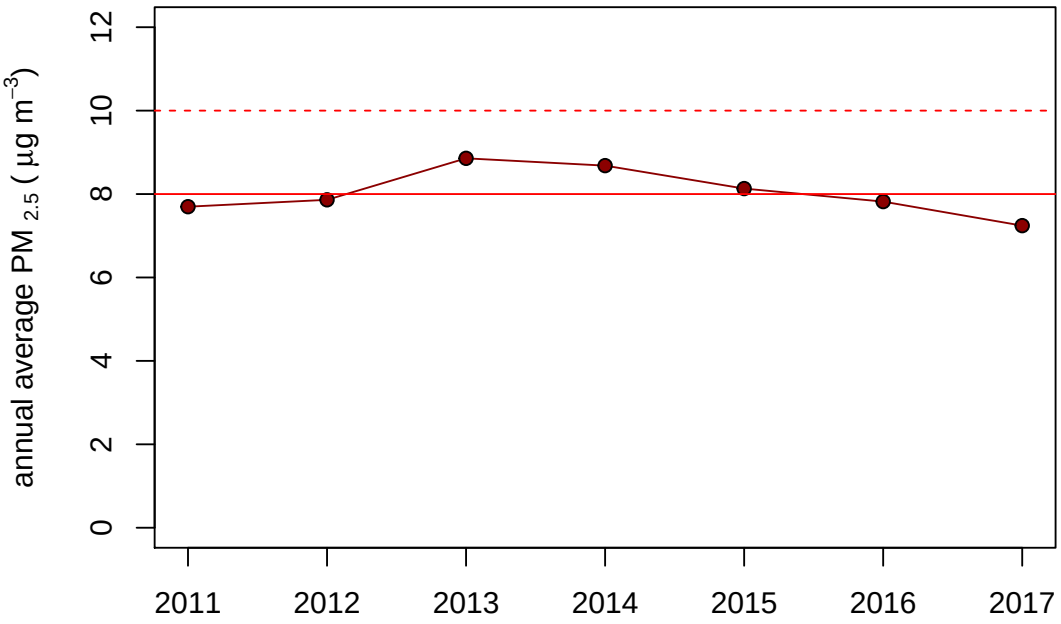


Figure 3: Annual average $PM_{2.5}$ levels at the Federal Building air station from 2011 until 2017. The solid red line indicates the provincial BCAQO of 8 $\mu gm^{-3}$. The effects of fires have been removed from the data used to calculate these statistics. $PM_{2.5}$ statistics at the Federal Building air station from 2011 until 2017. These values are based only on newer FEM instruments, the first full year of FEM derived data at the Federal air station was 2011. The technique used to remove the effects of wildfires was to replace daily averages during the summer forest fire season (July, August and September), that exceeded 28 $\mu gm^{-3}$, with the average values for the same day based on years where fires did not have a significant effect on $PM_{2.5}$ levels. For each day replaced, the average for that day in 2011, 2013 and 2016 was used.

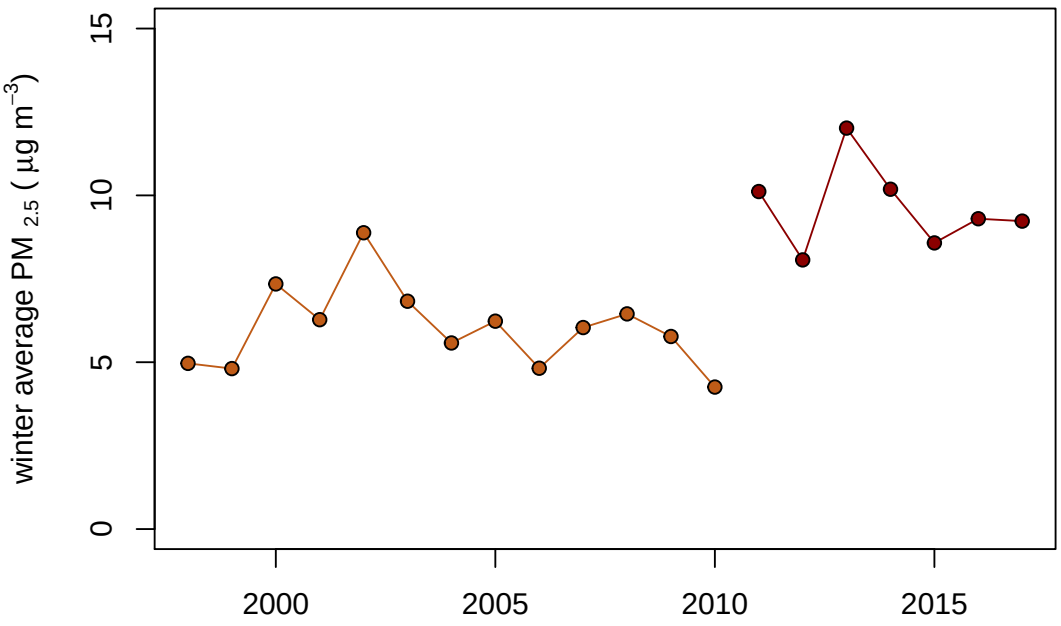


Figure 4: Trend in the average winter (Dec,Jan, Feb) $PM_{2.5}$ concentrations at the Mayfair (TEOM) and Federal (FEM) air stations. Values from the older TEOM instruments are shown in orange, those from the newer FEM instruments in red. Winter is the season when $PM_{2.5}$ concentrations are higher due to poor dispersion and increased local sources (heating).

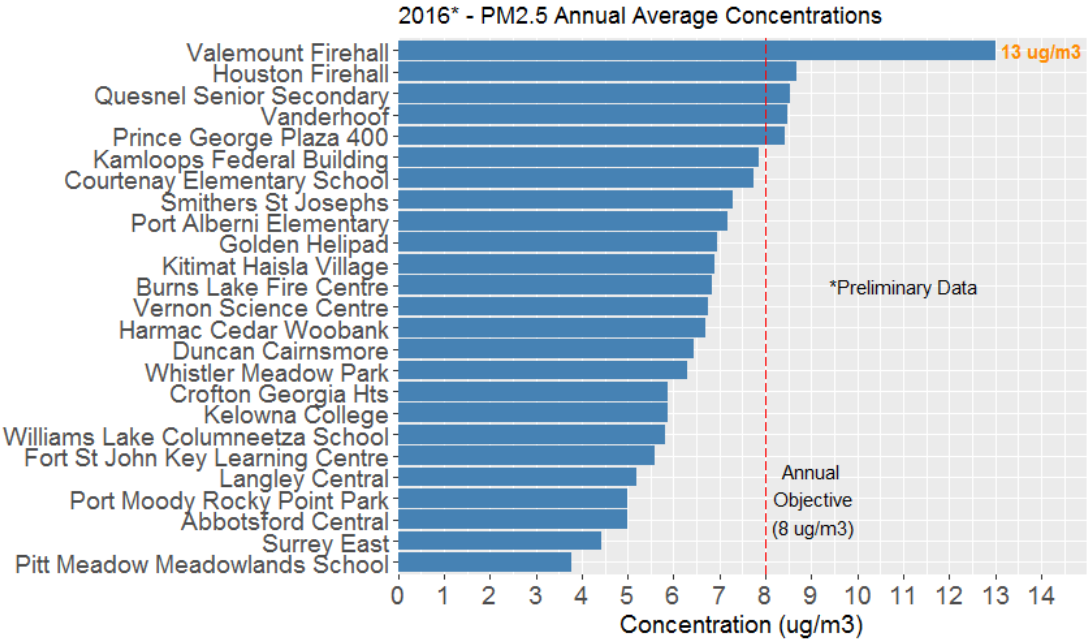


Figure 5: Annual average $PM_{2.5}$ concentrations for air quality stations in BC other than those in lower mainland for 2016. Due to the unprecedented values that occurred during the wildfires of 2017, the equivalent chart for 2017 is difficult to interpret. There were no significant forest fires fires that influenced interior airsheds in 2016. This graph was prepared by Gail Roth, BC Ministry of Environment.

| year | Mayfair | Federal | Firehall 2 |
|---|---|---|---|
| 1983 | | 30 | |
| 1984 | | 94 | |
| 1985 | | 56 | |
| 1986 | | 197 | |
| 1987 | 385 | 64 | |
| 1988 | 454 | 29 | |
| 1989 | 344 | 127 | |
| 1990 | 323 | 148 | |
| 1991 | 125 | 96 | |
| 1992 | 113 | 79 | |
| 1993 | 170 | 118 | |
| 1994 | 116 | 104 | |
| 1995 | 125 | 61 | |
| 1996 | 168 | 77 | |
| 1997 | 172 | 92 | |
| 1998 | 204 | 47 | |
| 1999 | 230 | 42 | |
| 2000 | 171 | 46 | |
| 2001 | 131 | 41 | |
| 2002 | 221 | 134 | |
| 2003 | 111 | 42 | |
| 2004 | 70 | 45 | |
| 2005 | 32 | 14 | |
| 2006 | 16 | 3 | |
| 2007 | 21 | | |
| 2008 | 8 | | |
| 2009 | 41 | | |
| 2010 | 77 | 17 | |
| 2011 | 9 | 13 | 1 |
| 2012 | | 2 | 2 |
| 2013 | | 6 | 2 |
| 2014 | | 8 | |
| 2015 | | 4 | |
| 2016 | | 13 | |
| 2017 | | 86 | |

Table 4: Hours per year when TRS was greater than 5 ppb, at the Mayfair Street, Firehall 2, and Federal Building air stations from 1983 until 2017. A mobile monitor was located at Firehall 2 for several years after the Mayfair site was closed.

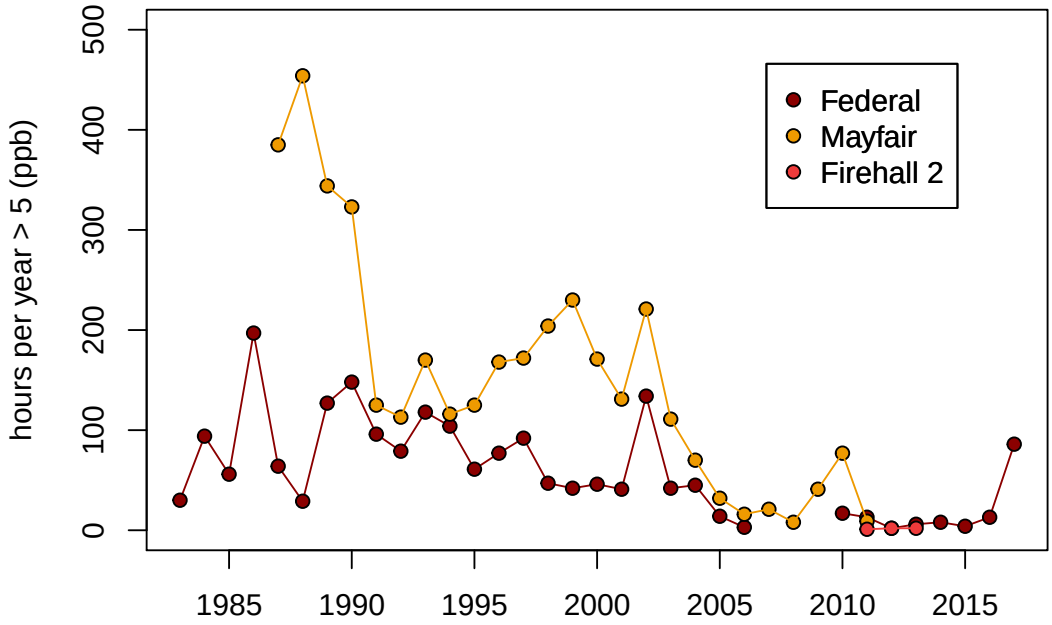


Figure 6: Trend in TRS exceedances at the Mayfair, Federal and Firehall 2 air stations.