

# **Assessment of Ambient PM<sub>10</sub> Levels Adjacent to a Poultry Barn Operation**

## **Aldergrove, BC**

**Ministry of Environment  
Lower Mainland Region  
10470 152 Street  
Surrey, British Columbia  
V3R 0Y3**

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## **Preface**

The study was undertaken by the Ministry of Environment Lower Mainland Regional Office (Surrey, British Columbia) in response to a complaint received by Environmental Protection Division staff. PM<sub>10</sub> sampling and assessment was undertaken by Mr. Rod Shead, Mr. Jason McCoy and Ms. Cindy Walsh. It is important to note that although the monitoring was undertaken by the Ministry of Environment, the monitoring site was within the boundaries of the Greater Vancouver Region District (GVRD).

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## 1. INTRODUCTION

### 1.1. *Background*

In October 2005, the Lower Mainland Regional office of the B.C. Ministry of Environment (MOE) received a complaint from an Aldergrove resident regarding dust emissions from a poultry farm operation located adjacent to their property. The complainant expressed concern over the impact of the poultry farm operation on local air quality and human health. They also raised concern over the operation's potential to affect the health of the community, particularly a nearby school. Concerns that the poultry dust was having a negative impact on the complainant's property in terms of aesthetic value and personal comfort were also raised.

Investigation of the complaint revealed significant background involving the complainant and the poultry operation in question. In May, 2001 a letter of complaint was filed with Ministry of Agriculture and Lands (MAL). The letter raised concern over certain farm practices occurring at the broiler breeder operation located on the property adjacent to the complainants property. This complaint was followed by a formal complaint to the British Columbia Farm Industry Review Board in August 2004 which stated, among other concerns, excessive poultry dust from the neighbouring farm.

In response to the 2004 complaint, the B.C. Poultry Hatching Egg Producers' Association (BHEPA) requested Intervener status in support of the respondent farm. Intervener status was granted and a British Columbia Farm Industry Review Board hearing was held April 2005. The hearing panel found that the respondent broiler breeder operation does produce dust. Consequently, the poultry farmer was ordered under the *Farm Practices Protection (Right to Farm) Act* to install fan hoods to direct fan exhaust to the ground. The farmer was also ordered to use a tarp system over the truck and clean up area to reduce dust levels during barn clean out, and is required to maintain the growth of an evergreen hedge between the two properties to minimize dust travel.

Regardless of the orders put in place by the British Columbia Farm Industry Review Board, the complainant remained concerned over the possible impact to air quality. As a result, B.C. MOE, in agreement with the GVRD, agreed to implement a short term ambient air quality monitoring program designed to assess ambient air quality in the vicinity of the poultry farm operation.

### 1.2. *Goals*

The goals of this study were to (a) provide a preliminary assessment of air quality in the vicinity of a poultry barn operation, using a complaint as the grounds for a case-study, and (b) to provide quantitative information to regulating agencies designed to initiate discussions and actions related to agricultural air quality issues pertaining to poultry barn operations.

### 1.3. *Pollutant Selection and Air Quality Objectives*

As the nature of the complaint relates to dust, particulate matter was chosen as the pollutant of interest. Ambient concentrations of PM<sub>10</sub> (referring to particulate matter having an aerodynamic diameter of less than 10 micrometers) will be used to assess ambient air quality in the vicinity of the poultry barn. PM<sub>10</sub> was selected over total dustfall or PM<sub>2.5</sub> due to instrument availability.

The Canadian Environmental Protection Act Federal/Provincial Working Group on Air Quality Objectives and Guidelines (WGAQOG), who previously developed National Ambient Air Quality Objectives for

airborne pollutants also recommended a 24-hour Reference Level of 25 µg/m<sup>3</sup> for PM<sub>10</sub>. PM<sub>10</sub> levels in excess of the Reference Level have demonstrated effects on human health and/or the environment. There is also a British Columbia 24-hour Ambient Air Quality Objective for PM<sub>10</sub> of 50 µg/m<sup>3</sup>. Although these levels provide guidelines, it is important to note that sensitive individuals may experience health effects at even very low particulate matter concentrations. In the context of human health, there is no safe level for particulate matter.

For the purposes of this study, the WGAQOG Reference Level of 25 µg/m<sup>3</sup> is referred to as the 24-hour PM<sub>10</sub> Health Reference Level and the Provincial Air Quality Objective of 50 µg/m<sup>3</sup> is referred to as the B.C. 24-hour PM<sub>10</sub> Ambient Air Quality Objective.

## 2. SAMPLING PROGRAM

The sampling program was designed to meet the goals of the study.

### 2.1. Sampling Program Objectives

The general objective of the ambient air sampling program was to determine if the poultry farm operation was introducing a waste, in this case poultry dust, into the environment in a *quantity* sufficient to alter or impair the usefulness of the environment. For purposes of this study, dust emissions from the poultry farm operation were considered to be a concern if:

- 1) There were exceedances of the Ambient Air Quality Objectives at the complainant's property; and,
- 2) Ambient air concentrations at the complainant's property were elevated relative to representative background ambient air concentrations.

It is important to note that both of the above-mentioned conditions are present to establish, quantitatively, an impact to the environment. The first condition simply establishes an exceedance of the Ambient Air Quality Objectives while the second condition localizes the exceedance to the area in question (in this case the complainant's property). Therefore, the specific objectives of the sampling program were to:

- 1) Determine if ambient concentrations of PM<sub>10</sub> at the complainant's property exceeded the B.C. Objective and Health Reference Levels for PM<sub>10</sub> as defined in section 1.3.
- 2) Determine if ambient concentrations of PM<sub>10</sub> at the complainant's property were elevated relative to background PM<sub>10</sub> concentrations.

### 2.2. Site Location

MoE staff visited the site in June 2006 to ensure suitability of the site for ambient air quality monitoring.

Two poultry barns (hereby named East barn and West barn) parallel the western boundary of the complainant's property. Hoods designed to direct dust downward to the ground were present on the east side of East barn. It was difficult to determine if fan hoods were present on the west side of the East barn, or on either side of the West barn, without entering the farmers property, but visual assessment from a distance indicated that fans were absent. An immature cedar hedge is located along the western border of the complainant's property (parallel to the barns). The complainant's residences are situated at the south end of the East barn, within 100 meters of the poultry barn exhaust fans.

Sampling equipment was sited to obtain representative ambient air samples at the complainant's property. The equipment was situated directly north of the residence and away from the driveway, at a location designed to assess human exposure. While the location of equipment did not meet all criteria for sitting a regional ambient air quality station due to the close proximity of trees and buildings, equipment locations were justified as they were sited to best achieve the objectives of the sampling program.



Figure 1 Monitoring location in relation to the poultry barns. (a) View south. (b) View north.



Figure 2 View west towards poultry barn from monitoring location.

### **2.3. Instrumentation**

A Hi-Vol PM<sub>10</sub> sampler was used to measure particulate matter. The Hi-Vol draws ambient air into the sampler and onto a pre-weighed 8 inch by 10 inch filter over a 24-hour period. Filters used in this study were sent to a laboratory for weighing and the resultant 24-hour PM<sub>10</sub> concentrations are expressed in  $\mu\text{g}/\text{m}^3$ .

## **2.4. Sampling frequency**

Ambient air was sampled at the complainant's property over 24-hour sampling periods. When available resources corresponded to times of favorable weather conditions (high pressure system, no expected precipitation), sampling was increased to every 3 days. The remainder of the sampling was at a frequency of every 6 days. The complainant was notified of the sampling schedule and was advised not to approach the monitor, or to mow the lawn during the 24 hour sampling period.

## **2.5. Background site**

The Langley GVRD Ambient Air Quality Monitoring Station is representative of local and regional ambient air quality and was selected for use in this study as the background site. PM<sub>10</sub> is continuously monitored at this site using a Tapered Element Oscillating Microbalance (TEOM) and the data is available as hourly average PM<sub>10</sub> concentrations. Hourly Langley PM<sub>10</sub> data corresponding to the sampling dates at the complainant site were collected and 24-hour PM<sub>10</sub> concentrations were computed. The resulting 24-hour concentrations from the Langley station were used for comparison with the 24-hour PM<sub>10</sub> concentrations measured at the complainant site. In the absence of data from the Langley station the next closest GVRD Ambient Air Quality Monitoring Station, Surrey East, was used.

The reader should note that the comparison of GVRD monitoring station data with data collected at the complainant's property does not take into consideration differences in the monitoring instrumentation.

## **3. SAMPLING RESULTS**

Between June 7<sup>th</sup> and October 20<sup>th</sup>, 2006 there were 23 24-hour ambient PM<sub>10</sub> sampling periods. Results from the sampling period are provided in Appendix A.

Comparison of the complainant property PM<sub>10</sub> data set with the PM<sub>10</sub> data set from the Langley background site shows that there is a similar, but offset trend in the PM<sub>10</sub> results. **This trend shows that PM<sub>10</sub> concentrations measured at the complainant's property were elevated relative to the Langley ambient air quality station for all sampling dates.** PM<sub>10</sub> concentrations from the complainant site ranged between 12 and 211 percent higher than background concentrations.

**Concentrations measured at the complainant's property exceeded the 24-hour Health Reference Level of 25 µg/m<sup>3</sup> on 16 out of 23 sampling dates. The B.C. 24-hour Ambient Air Quality objective of 50 µg/m<sup>3</sup> was exceeded twice during the study period; once on June 25<sup>th</sup> and a second time on September 2<sup>nd</sup>, with concentrations of 55 and 59 µg/m<sup>3</sup>, respectively. The background site exceeded the 24-hour PM<sub>10</sub> Health Reference Level of 25 µg/m<sup>3</sup>, once during the study period, on September 2<sup>nd</sup>, with a concentration of 26 µg/m<sup>3</sup>. See Figure 1.3 for a graphical representation of the data and Appendix B for the full size graph.**

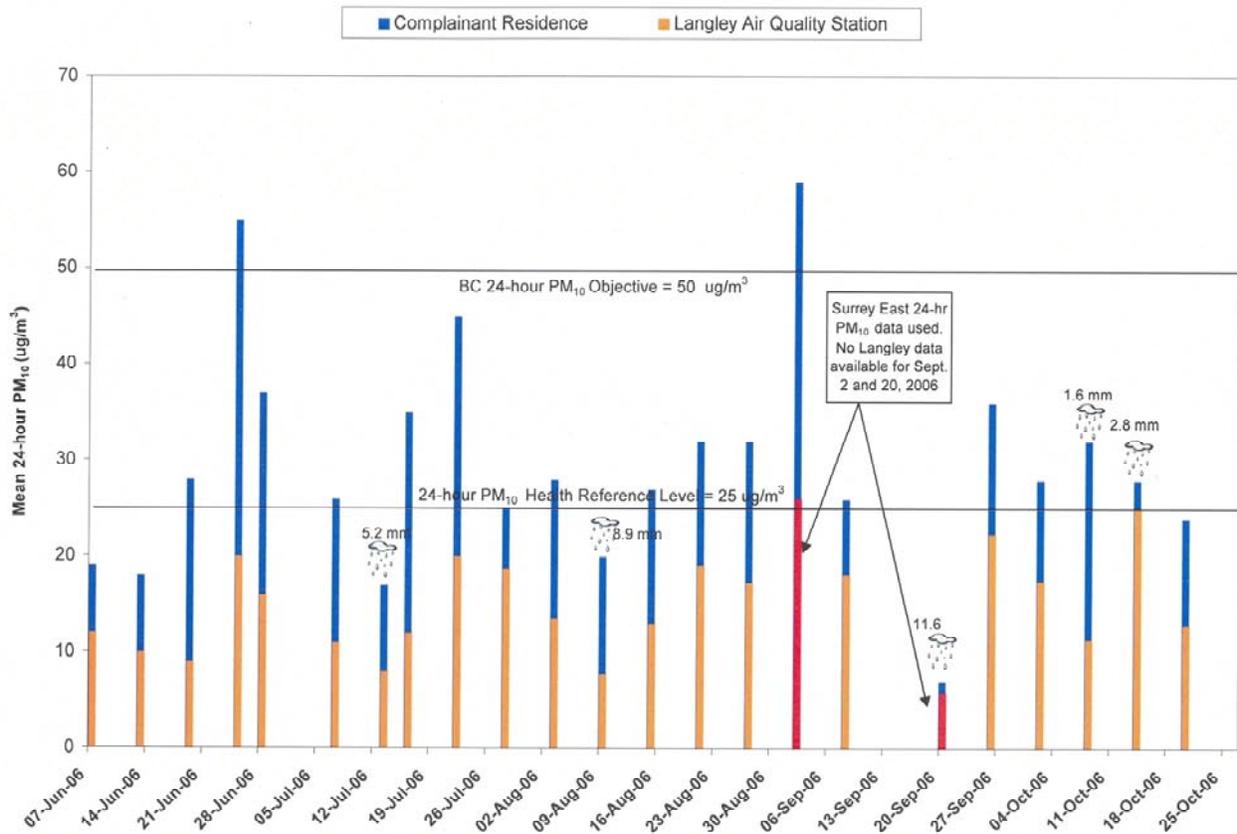


Figure 3 PM<sub>10</sub> sampling results for the complainant property and the background station. Note: Data from the Langley air quality station was gathered using a TEOM, whilst data from the complainant residence was collected using a Hi-Vol.

### 3.1. Summary of Results

Results of the sampling program indicate:

1. The 24-hour PM<sub>10</sub> Health Reference Level of 25 µg/m<sup>3</sup> established for this study was exceeded at the complainant's property for 16 out of 23 valid sampling periods. The B.C. 24-hour PM<sub>10</sub> objective of 50 µg/m<sup>3</sup> was exceeded twice.
2. PM<sub>10</sub> levels at the complainant's property were elevated relative to the background site for 23 of the 23 sampling periods; PM<sub>10</sub> levels at the complainant property were elevated between 12 and 211 percent higher over background levels.

## 4. DISCUSSION

### 4.1. Study Findings

Ambient PM<sub>10</sub> concentrations at the complainant's property exceeded the 24-hour PM<sub>10</sub> Health Reference Level of 25 µg/m<sup>3</sup> on 16 of the 23 sampling dates. Additionally, ambient concentrations of PM<sub>10</sub> at the

complainant's property were elevated relative to background PM<sub>10</sub> concentrations on all sample dates; with PM<sub>10</sub> levels at the complainant's property elevated between 12 and 211 percent higher than background levels.

## **4.2. Study Limitations**

Limitations of this study included intermittent monitoring at the complainant site combined with different monitoring methods between "background" and the complainant site.

On 2 of the 23 sampling dates the Surrey East GVRD Ambient Air Quality Monitoring Station data was used for background due to the absence of data from the Langley GVRD Ambient Air Quality Monitoring Station. Referring to Figure 3 or Appendix B, the Surrey East site was used as background on Sept. 2 and 20<sup>th</sup>, 2006. On Sept. 20<sup>th</sup> PM<sub>10</sub> levels were the highest measured on the complainant's property. Although, the Surrey East station is the next closest station to the Langley station, it does not represent local and regional ambient air quality as accurately as the Langley station; providing information for a relative, rather than a quantitative comparison to PM<sub>10</sub> levels at the complainant's property.

Regarding the sampling methodology, as the non-continuous PM<sub>10</sub> samples were taken on a 6 day cycle at the complainant's property, short-term episodes, and long-term cumulative impacts on property and possessions could not be assessed. Considering that the B.C. Objective for PM<sub>10</sub> is based on a 24-hour average, it is not thought that this limitation compromises the interpretation of results. It is noteworthy that the sampling methodology may have failed to see all short-term episodes at the complainant's property.

Limitations of the study could be addressed with the implementation of a continuous monitoring program (with TEOM instrumentation) at the complainant's residence.

## **5. CONCLUSIONS**

Sampling results indicate that poultry farm operation activities are likely causing an increase in the ambient levels of PM<sub>10</sub> above levels recorded at nearby background sites. The observed increases are likely attributed to fans located on the east side of the barn which result in dust emissions from the barns being transported eastward toward the complainant's property. The presence of fan hoods on the side of the barn closest to the complainant property does not appear to protect the ambient air environment. The effect of the dust emissions settling on property and possessions is detrimental in terms of aesthetics and personal inconvenience, but the main concern is the impact on human health. Ambient Air Quality Objective Levels were exceeded, but it is important to note that health effects are possible at levels lower than the Health Reference Level stated in this study.

## **6. RECOMMENDATIONS**

- That MoE and the GVRD consider additional monitoring at the complainant property (or other relevant site), which may include, but is not limited to, continuous monitoring with a TEOM instrument in proximity to a poultry barn operation.
- That MoE, GVRD, and other regulating agencies meet to discuss this poultry barn operation and its potential impact on air quality.
- That MoE, in cooperation with other interested parties, liaise with poultry farming groups on the issue of poultry farm emissions.
- That the Ministry of Environment support the development of a Best Management Practices document created by industry and other relevant stakeholders with the intent to encourage mitigation of poultry barn emissions.

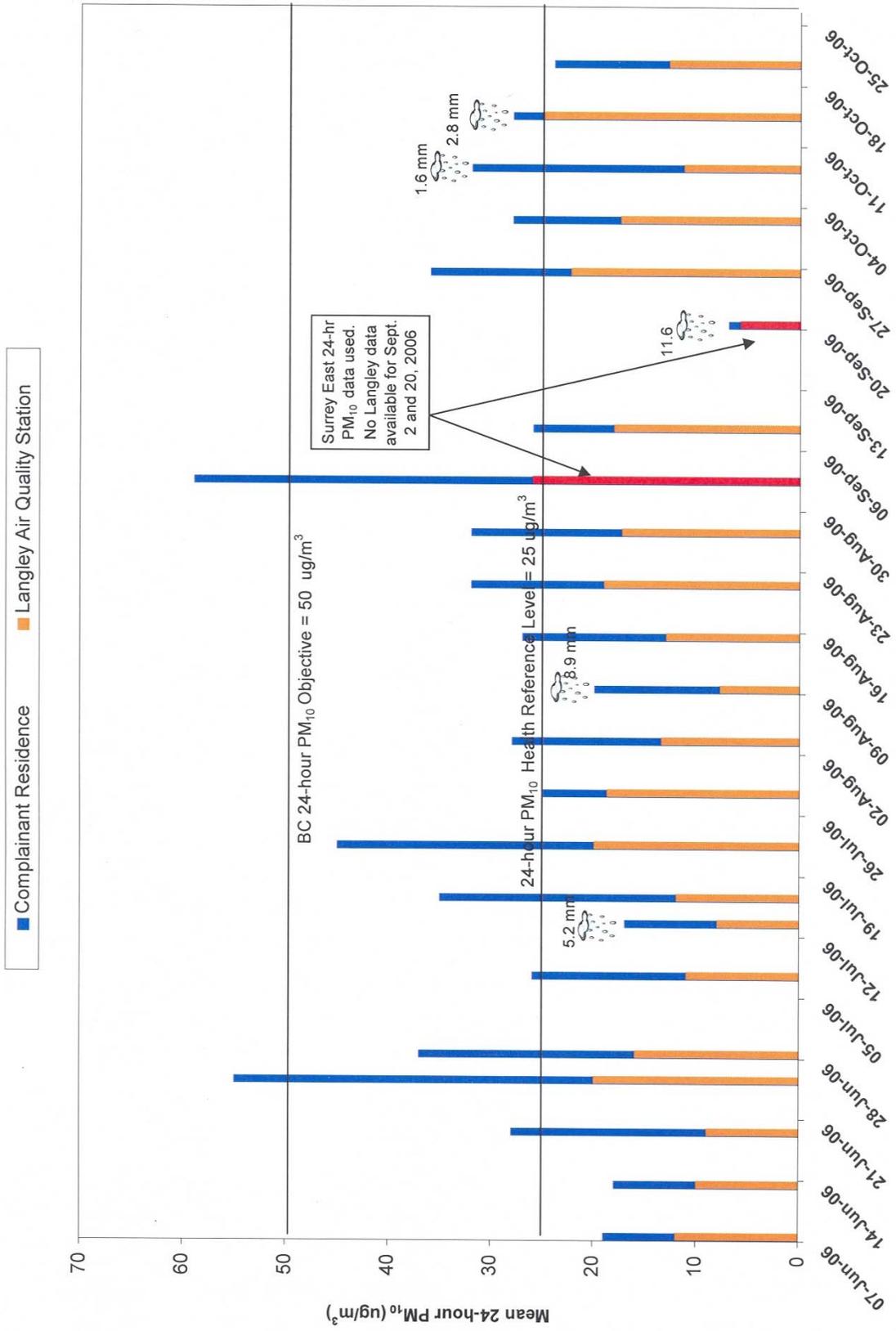
## APPENDIX A

Date	Langley Air Quality Station µg/m3	Complainant Residence µg/m3
Wed, June 7, 2006	12	19
Tue, June 13, 2006	10	18
Mon, June 19, 2006	9	28
Sun, June 25, 2006	20	55
Wed, June 28, 2006	16	37
Fri, July 7, 2006	11	26
Thu, July 13, 2006	8	17
Sun, July 16, 2006	12	35
Sat, July 22, 2006	20	45
Fri, July 28, 2006	19	25
Thur, Aug 3, 2006	14	28
Wed, Aug 9, 2006	8	20
Tue, Aug 15, 2006	13	27
Mon, Aug 21, 2006	19	32
Sun, Aug 27, 2006	17	32
*Sat, Sept 2, 2006	26	59
Fri, Sept 8, 2006	18	26
Thur, Sept 14, 2006	no sample	no sample
*Wed, Sept 20, 2006	6	7
Tues, Sept 26, 2006	22	36
Mon, Oct 2, 2006	18	28
Sun, Oct 8, 2006	11	32
Sat, Oct 14, 2006	25	28
Thur, Oct 20, 2006	13	24

\* East Surrey Air Quality Station

Note: Data from the Langley air quality station was gathered using a TEOM, whilst data from the complainant residence was collected using a Hi-Vol.

# APPENDIX B



Note: Data from the Langley air quality station was gathered using a TEOM, whilst data from the complainant residence was collected using a Hi-Vol.