

Exposure of Children to School Bus Exhaust

New Brunswick Lung Association

New Brunswick Dept. of Education

Health Canada

Environment Canada

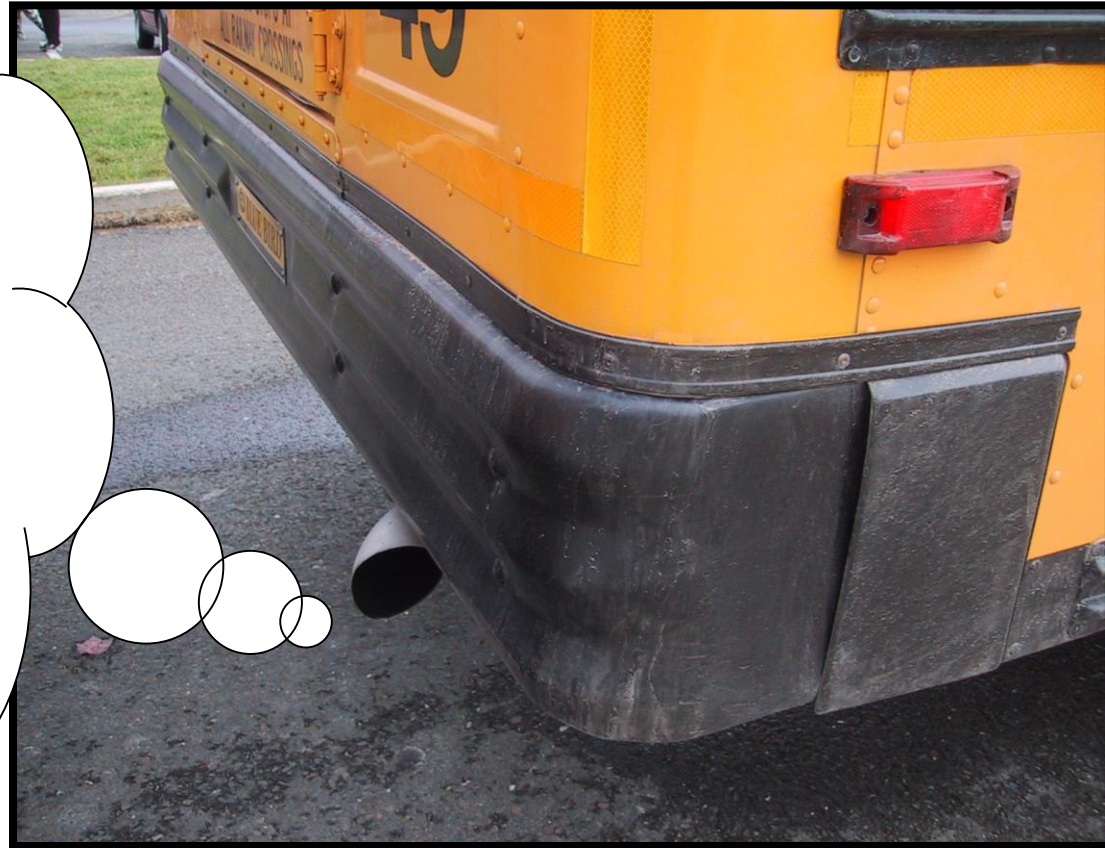
Dr. David Brown EHHI, Dr Thelma Green RPC



Diesel emissions are a complex mixture of hazardous particles, gases and vapours

CO₂

**PM_{1.0}, PM_{2.5}
CO, VOCs including
polycyclic aromatic
hydrocarbons
benzene, 1,3-butadiene,
toluene and xylene,
aldehydes**



Health effects



Symptoms most often associated with diesel exhaust exposure are:



irritation of the eyes and nose



broncho-constriction



cough and signs of laboured breathing



chest tightness and wheezing



Diesel exhaust is a probable human carcinogen.

Population health



Respiratory diseases are increasing in North America and are becoming one of the leading causes of death (Statistics Canada, 1997)



Air pollution plays an important role in the development of several respiratory conditions:



infections such as bronchitis and pneumonia



exacerbation of chronic obstructive lung disease and asthma



decreased lung function and lung growth



lung cancer



It also contributes to higher rates of heart attacks.

Asthma and children



Studies have shown a causal relationship between traffic congestion, diesel exhaust and asthma (English et al., 1999; Ciccone et al., 1998, cited in Wargo et al., 2002).



Asthma accounts for one quarter of school absenteeism and is the most common chronic disease plaguing children.



In 2000/01, 8.7% of Canadians four years of age and over suffered from asthma.



Between 1995 and 1999 the prevalence of asthma had increased by 14% among children between ages 4 and 11. It occurs currently in approximately 7 to 10% of children (Health Canada, 2002; Canadian Lung Association, 2004)



In New Brunswick, in 2000/01, there were 8652 young people between the ages of 12 and 19 suffering from asthma.

School Bus Study



Objectives



To determine the exposure of New Brunswick children to fuel exhaust-related pollutants on their daily way to school.



To improve our understanding of the exposure of New Brunswick school children to diesel exhaust relative to the age of the bus and the length of the bus route.



To offer policy recommendations based on the findings.

Methods



Compounds measured were PM 1.0, PM 2.5, black carbon, and volatile organic compounds.



A Dust Trak air monitor sampled continuous levels of particulate matter 2.5 μg and smaller. A P-Trak sampled PM 1.0 μg and smaller. An aethalometer measured levels of black carbon (BC) and UV-absorbing aromatic material. SUMMA cannisters were used to take “total-trip” samples of volatile organic compounds (VOCs).



The research assistants recorded all relevant events in a log for each entire day.



Data exists for 63 sampling days, over 75 bus rides and 11 walking routes.



Results



Riding the bus exposes children to 3-5 times higher levels of PM_{2.5}, and 2-3 times higher PM_{1.0} than does walking to school. Levels of VOCs were higher on buses but the variability could not be explained by age of bus or duration of route.



Short bus rides have higher mean and maximum exposures to PM_{2.5}.



Long bus rides had higher cumulative exposures to PM_{2.5}, PM_{1.0} and black carbon compared with short rides.



The age, mileage, and type of fuel injection system (mechanical or electric) did not strongly affect exposures to PM_{2.5}.



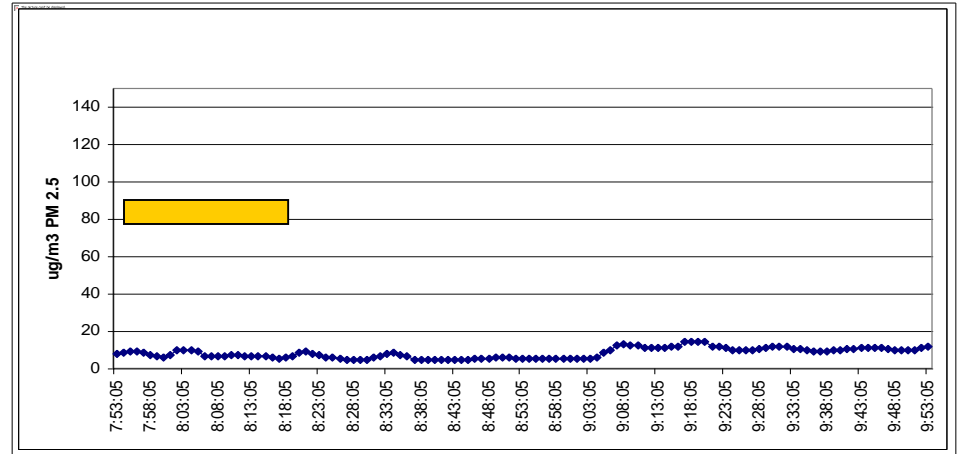
Colder temperatures tended to increase PM_{1.0} and higher humidity increased PM_{2.5}.



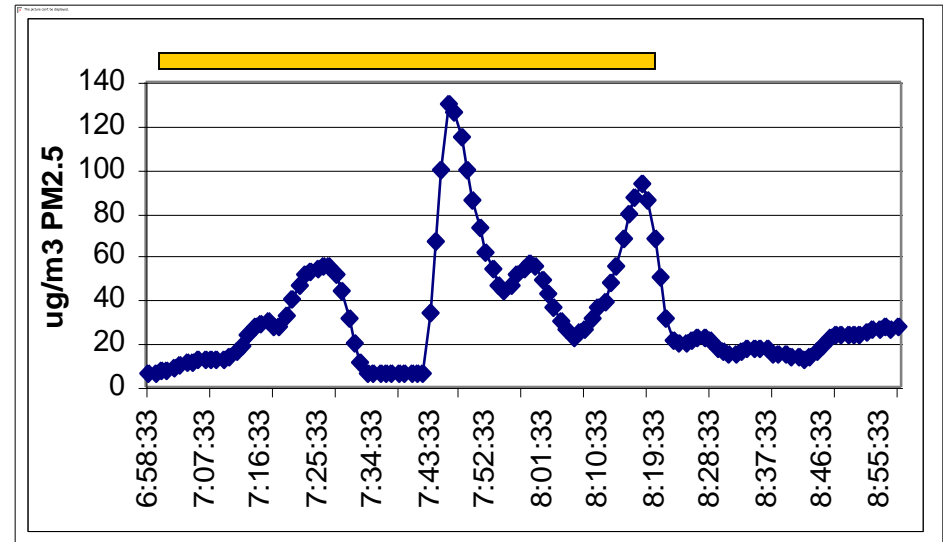
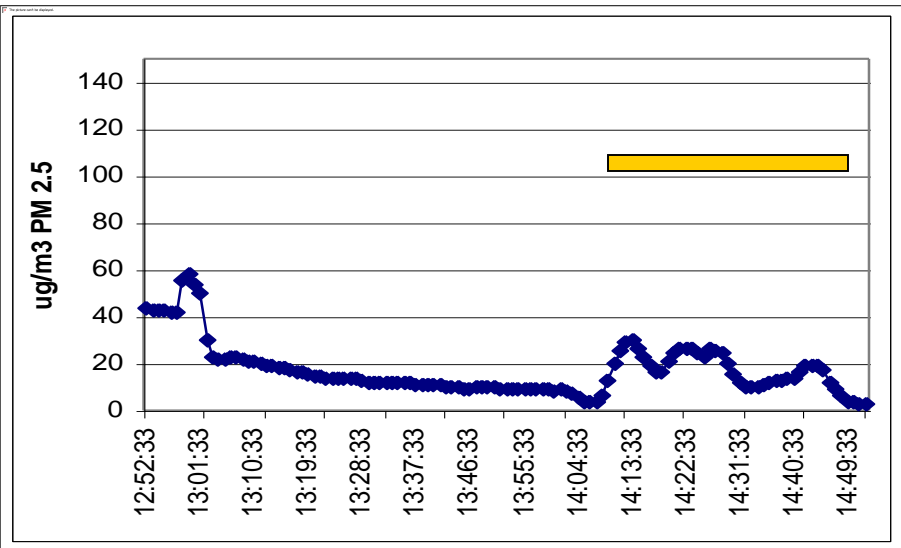
Higher ambient PM_{2.5} tended to increase PM_{2.5} inside buses.

Examples PM2.5 exposure

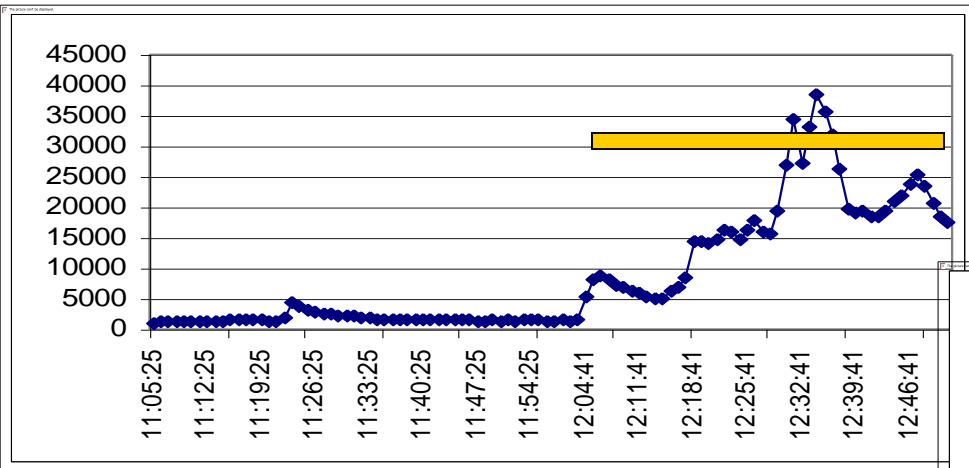
Walking



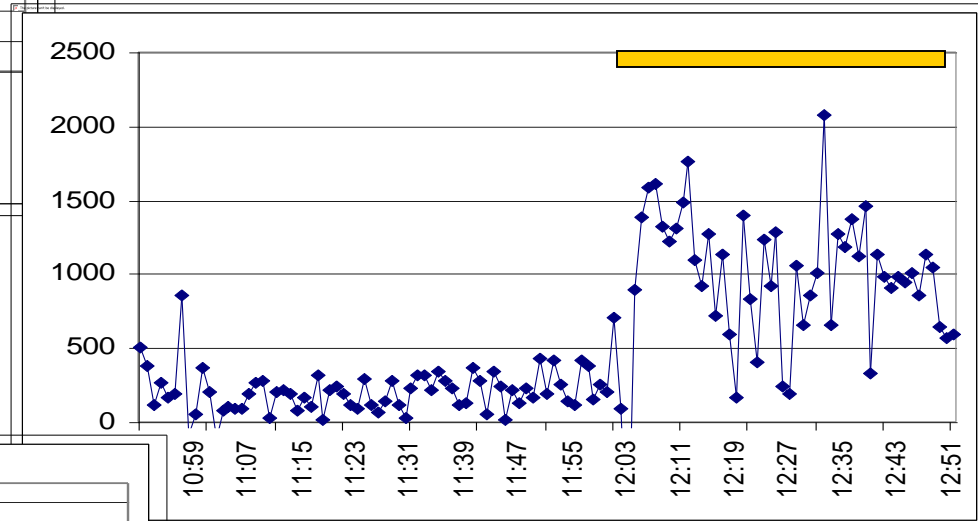
Riding the bus



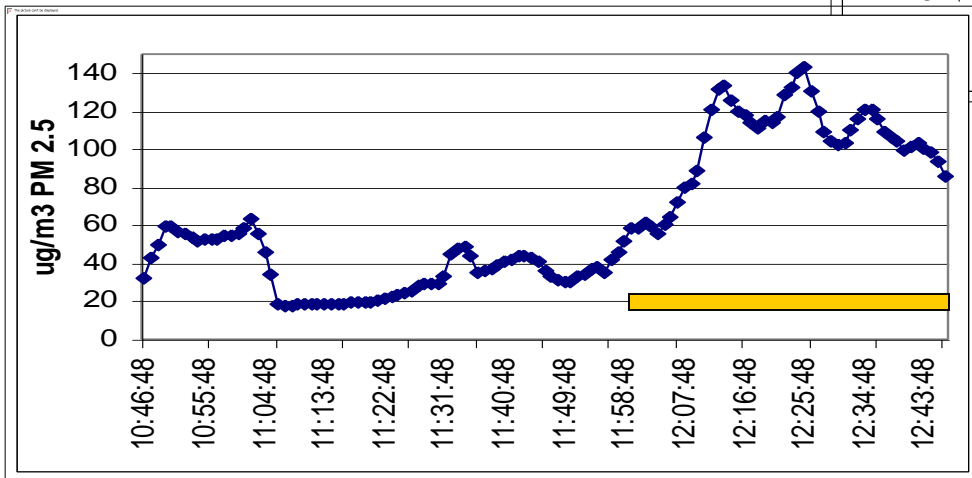
Same bus ride: PM1.0, Black carbon, PM2.5



PM1.0 counts/m³



Black Carbon ng/m³



PM2.5 ug/m³

Recommendations



Eliminate bus idling



Implement no-idling policy for all vehicles on school grounds



Avoid caravanning



Consider reducing the number of stops or relocating stops to areas with lower traffic density



Locate exhaust pipes to upper left of rear of bus



Air-filtering systems should be considered



Retrofit diesel buses to achieve lower emissions



New buses should have lowest emissions possible



For the health of your children,
please turn off your engine at
drop-off and pick-up times.

