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10 OUR CHILDREN'S EARTH FOUNDATION, and
11 COMMUNITIES FOR A BETTER ENVIRONMENT

12 **IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA**

13 **IN AND FOR THE COUNTY OF SAN FRANCISCO**

14 ENVIRONMENTAL LAW FOUNDATION; OUR
15 CHILDREN'S EARTH FOUNDATION; and
16 COMMUNITIES FOR A BETTER
17 ENVIRONMENT, On Behalf of the General Public

18 Plaintiffs,

19 v.

20 LAIDLAW TRANSIT INC. dba LAIDLAW
21 EDUCATION SERVICES; LAIDLAW TRANSIT
22 SERVICES, INC.; DURHAM SCHOOL
23 SERVICES; DURHAM SCHOOL SERVICES,
24 L.P.; NATIONAL EXPRESS CORPORATION; and
25 DOES 1 through 100, inclusive,

26 Respondents.

CASE NO.: CGC-06-451832

**DECLARATION OF CAMILLE
SEARS, M.S., IN SUPPORT OF
PLAINTIFFS' MOTION FOR
PRELIMINARY INJUNCTION**

[CCP §437c]

Date: June 8, 2007

Time: 1:30 p.m.

Court: Dept. 613

Judge: Hon. Ernest H. Goldsmith

Complaint filed: May 2, 2006

Trial Date: Sept. 4, 2007

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(Continuation of listing of additional counsel)

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1 I, Camille Sears, M.S., hereby declare:

2 1. I have personal knowledge of the following and could competently testify thereto if
3 called as a witness.

4 **Education and Experience**

5 2. I hold B.S. (1978) and M.S. (1980) degrees in Atmospheric Science from the University
6 of California at Davis. Atmospheric Science is the study of the physical processes that
7 occur in the atmosphere, including the study of meteorology, reflection and absorption of
8 light, dispersion of pollutants, wind patterns, and other phenomena.

9 3. Since 1982 I have been engaged in research, consulting, and enforcement work in the
10 field of air quality. I have been self-employed since 1992. From 1988 to 1992, I was the
11 Air Toxics Program Coordinator for the Santa Barbara County Air Pollution Control
12 District. From 1987 to 1988, I was a Senior Scientist at URS Consultants. From 1983 to
13 1987, I served as an Air Quality Engineer for the Santa Barbara County Air Pollution
14 Control District. From 1982 to 1983, I was a Meteorologist with Dames and Moore, a
15 consulting firm.

16 4. I specialize in atmospheric dispersion modeling, which uses regulatory-approved
17 computer programs to estimate chemical concentrations in the air. I have prepared well
18 over 1,000 air dispersion modeling analyses requiring on-site or site-specific
19 meteorological data. I have extensive experience with many different air dispersion
20 programs, including the ISC, AERMOD, OCD, MPTER, COMPLEX-I, CRSTER, and
21 other plume models, as well as the MESOPUFF, MESOPUFF II, INPUFF, and
22 CALMET/CALPUFF puff models. I have prepared numerous indoor air quality analyses
23 using both measured data and model calculations.

24 5. I sited and specified the requirements for over 30 air quality and meteorological
25 monitoring stations while I was employed with the Santa Barbara County Air Pollution
26 Control District. I developed detailed technical protocols for siting these stations and for
27 ensuring that the data meet regulatory and other air dispersion modeling requirements.

- 1 6. I have extensive experience in the enforcement of regulatory programs for air quality,
2 particularly in the implementation and technical work required for AB 2588, the Air
3 Toxics Hot Spots Act (HSC 44300 et seq.), and Proposition 65, the Safe Drinking Water
4 and Toxic Enforcement Act of 1986 (HSC 25249.5 et seq.). In addition to the
5 professional positions referenced above, I have also served as an expert providing
6 testimony, analysis and advice on toxic air pollutants, and in calculating concentrations of
7 toxins in the ambient air, their dispersion and the pattern and levels of public exposure
8 that would result and the risks to the surrounding community for the California Attorney
9 General, the Los Angeles County District Attorney, the California Energy Commission,
10 the Santa Barbara County Air Pollution Control District, the South Coast Air Quality
11 Management District, the California Office of Environmental Health Hazard Assessment,
12 and for business, environmental, and community groups.
- 13 7. In particular for AB 2588, I co-developed the mathematical, computer-based model for
14 predicting community exposures to toxic air pollutants that is distributed by CAPCOA,
15 the California Air Pollution Control Officers' Association. These measurements of
16 exposure are often called Health Risk Assessments. CAPCOA is a voluntary association
17 of state and local government officials, largely engineers and scientists responsible for air
18 pollution control in California. The computer model I co-developed has been used by air
19 districts throughout the state in evaluating AB 2588 submissions by facilities covered by
20 the law, and used extensively by consultants who prepare AB 2588 submissions for the
21 facilities. I provided technical support on using this model for over 13 years. Recipients
22 of this support included regulatory agencies, industrial sources, and consulting firms.
- 23 8. I have prepared hundreds of health risk assessments of major air toxics sources in
24 California and the United States, many of which included calculation of soil and water
25 concentrations resulting from deposition of toxic air pollutants. In addition, I have
26 reviewed hundreds of submissions under AB 2588, both in Santa Barbara County and
27 throughout the state. These submissions include everything from raw data, through

1 model inputs, meteorological data, Air Toxics Emission Inventory Plans, Air Toxics
2 Emissions Inventory Reports, and draft and final Health Risk Assessments.

3 9. While employed at the Santa Barbara County Air Pollution Control District, I
4 participated in developing the Guidelines and Regulations used to implement the AB
5 2588 program. I was a member of the AB 2588 Criteria and Guidelines Technical
6 Guidance Committee. This committee was responsible for developing the AB 2588
7 Criteria and Guidelines Regulation and the Technical Guidance Document used to
8 implement the Regulation. The Guidelines and the accompanying Technical Guidance
9 Document are required for preparing the emission inventory plans and reports. I was a
10 member of the CAPCOA Risk Prioritization Guidelines, Risk Assessment Guidelines,
11 and Risk Notification Guidelines Committees. These committees created the AB 2588
12 Risk Prioritization, Assessment, and Notification Guidelines used in the AB 2588
13 program. I was also a member of the CAPCOA Air Toxics Policy Committee.

14 10. I have wide-ranging experience in verifying compliance with the warning provisions of
15 Proposition 65. I have performed Proposition 65 exposure assessments for over 120
16 facilities; I have reviewed scores of other Proposition 65 assessments.

17 11. I have taught several courses on air pollution and toxic chemicals for the University of
18 California at Santa Barbara Extension. I have served as a guest lecturer for the
19 University Extension certificate program in hazardous materials management, and for the
20 University's environmental studies program. I have taught air toxics risk assessment to
21 university professors through the National Science Foundation Faculty Enhancement
22 Program. I have trained many regulatory agency staff on calculating air pollution
23 emissions inventories, performing air dispersion modeling, and preparing health risk
24 assessments.

25 12. A true and correct copy of my curriculum vitae is attached hereto as Exhibit A.

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1 **Diesel Exhaust is a Carcinogenic Toxic Air Contaminant**

- 2 13. Diesel engine exhaust is classified by the State of California as a toxic air contaminant
3 (TAC) and as a chemical known to cause cancer in humans. (California Office of
4 Environmental Health Hazard Assessment, “Health Risk Assessment for Diesel Exhaust”
5 (May 1998) (PLTF 762-797) (Exhibit H to Declaration of Prof. Eduardo Behrentz, Ph.D.,
6 (Ex. H to Behrentz Dec.))
- 7 14. Exposure to diesel engine exhaust is recognized by the California EPA and other
8 agencies as a significant public health risk – in urban areas it is the largest contributor to
9 inhalation excess cancer risk. Although there are many toxic constituents in diesel
10 exhaust, e.g. benzene, aldehydes, and metals, it is the diesel particulate matter (DPM) that
11 is regulated under Proposition 65. The State of California has developed a cancer
12 potency slope for DPM, which is used for preparing inhalation health risk assessments.
13 DPM is a very potent carcinogen – on a gram-per-gram basis it is over ten times more
14 potent than benzene. (Consolidated Table of OEHHA/ARB Approved Risk Assessment
15 Health Values, Updated April 25, 2005 (Ex. B))

16 **Self-Pollution Exposure from Diesel Engine Bus Exhaust**

- 17 15. Various peer-reviewed journal articles and published studies have examined DPM levels
18 on school buses. These studies examined not only the DPM levels on the bus, but also
19 the “self-pollution” component, or the bus’s own exhaust entering the cabin. The
20 declaration of Prof. Eduardo Behrentz, Ph.D., discusses these analyses in detail. I have
21 reviewed the following studies, which are included as exhibits in the declaration of Prof.
22 Behrentz:
- 23 • California Air Resources Board (“CARB”), “Characterizing the Range of Children’s
24 Pollutant Exposure During School Bus Commutes” (October 10, 2003) (“CARB Study”)
25 (Ex. B to Behrentz Dec.);
 - 26 • E. Behrentz, et al, “Measuring Self-Pollution in School Buses Using a Tracer Gas
27 Technique,” 38 Atmospheric Environment p. 3735 (Apr. 2004) (Ex. C to Behrentz Dec.);

- 1 • E. Behrentz, et al., “Relative Importance of School Bus-Related Microenvironments to
2 Children’s Pollutant Exposure,” *Journal of Air and Waste Management Association*
3 (2005) (Ex. D to Behrentz Dec.);
- 4 • J. Marshall, E. Behrentz, “Vehicle Self-Pollution Intake Fraction: Children’s Exposure to
5 School Bus Emissions,” 39 *Environ. Science and Technology* 2559 (2005) (Ex. E to
6 Behrentz Dec.);
- 7 • L. Sabin, E. Behrentz, et al., “Characterizing the Range of Children’s Air Pollutant
8 Exposure During School Bus Commutes,” 15 *Journal of Exposure Analysis and*
9 *Environmental Epidemiology* 377 (2005) (Ex. F to Behrentz Dec.);
- 10 • L. Sabin, et al., “Analysis of Real-Time Variables Affecting Children’s Exposure to
11 Diesel-Related Pollutants During School Bus Commutes in Los Angeles,” 39
12 *Atmospheric Environment* 5243 (2004) (Ex. G to Behrentz Dec.);
- 13 • Solomon, et al., “No Breathing in the Aisles: Diesel Exhaust Inside School Buses,”
14 (2001) (Ex. N to Behrentz Dec.);
- 15 • Borak, et al., “Comparison of NIOSH 5040 Method versus Aethalometer to Monitor
16 Diesel Particulate in School Buses and at Work Sites,” 64 *American Industrial Hygiene*
17 *Assoc.* 260, at 264 (Mar./Apr. 2003) (Ex. P to Behrentz Dec.).

18 **CARB Measurements**

19 16. In 2002, the California Air Resources Board (“CARB Study”) conducted a detailed study
20 measuring black carbon levels on a variety of diesel-powered school buses. To assess a
21 range of bus ages similar to those commonly in use in California, the following school
22 buses were tested multiple times:

- 23 • 1985 Thomas Coach, 14 rows, Cat 3208 10.4 liter engine (HE1);
- 24 • 1985 Crown Supercoach, 15 rows, Detroit Diesel 671 6 liter engine (HE2);
- 25 • 1975 Crown Supercoach, 15 rows, Cummins 290 6 liter engine (HE3);
- 26 • 1998 Thomas Saf-T-Liner, 14 rows, Cummins 250 HP 8.3 liter engine (RE1);
- 27 • 1993 Thomas Saf-T-Liner, 13 rows, Cat 3116 6.6 liter engine (RE2);

- 1 • 1998 Thomas Saf-T-Liner, 14 rows, Cummins 250 HP 8.3 liter engine with particulate
2 trap (T01);
 - 3 • 2002 Thomas Saf-T-Liner, 14 rows, John Deere 8.1 liter CNG engine (CNG).
4 (CARB Study, p. 18. (Ex. B to Behrentz Dec.))
- 5 17. Black carbon levels were measured on all buses using Aethalometers. Self-pollution
6 rates were measured through use of a sulfur hexafluoride tracer gas. The buses without
7 particulate traps were found to have black carbon levels ranging from 5 micrograms per
8 cubic meter ($\mu\text{g}/\text{m}^3$) to $19 \mu\text{g}/\text{m}^3$, depending on bus model and age. (CARB Study, Table
9 5.3.3.1, p. 112 (Ex. B to Behrentz Dec.)) Typical urban background levels of black
10 carbon are roughly $2 \mu\text{g}/\text{m}^3$ (Id., Table 6.1, p. 165).
- 11 18. DPM is not directly measured as it is difficult to separate the diesel-generated component
12 from the total particulates in the sample. Instead, DPM concentrations are calculated
13 from measurements of either black carbon or elemental carbon. (CARB, “Proposed
14 Identification of Diesel Exhaust as a Toxic Air Contaminant.” Appendix III, Part A,
15 Exposure Assessment (April 22, 1998), p. A-45 (Ex. C)) Elemental carbon, which is
16 non-volatile, has been found to comprise approximately 64% of diesel exhaust by weight.
17 (Id. A-63) Thus, DPM concentrations are 1.56 (1 divided by 0.64) times measured
18 elemental carbon values. Black carbon, which is measured by the Aethalometer, is a
19 subset of elemental carbon measurements. Aethalometer studies in seven U.S. cities
20 found elemental carbon to be about 76.5% black carbon by weight. (P. Babich et al.,
21 “Method Comparisons for Particulate Nitrate, Elemental Carbon, and PM2.5 Mass in
22 Seven U.S. Cities,” 50 *Journal of Air and Waste Management Association* (2000), p.
23 1099. (Ex. D)) Accordingly, a factor of 2.04 (1.56 divided by 0.765) is used to convert
24 black carbon measurements to DPM concentrations. (CARB Briefing Paper,
25 “Characterizing the Range of Children’s Pollutant Exposure During School Bus
26 Commutes,” No. 00-322 (Oct. 2003), p. 13 (Ex. E))

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19. Laidlaw has very similar or identical school buses in its California fleet to those tested by the California Air Resources Board. The following table compares the buses tested in the CARB study with the detailed California fleet mix provided to Plaintiffs by Laidlaw:

Bus Tested by CARB	Laidlaw Bus
1975 Crown Supercoach, 15 rows, Cummins 290 engine (HE3)	Laidlaw reports one active Crown school bus with a Cummins 290 engine, model year 1980, Asset No. 18674
1985 Thomas Coach, 14 rows, Caterpillar 3208 engine (HE1 – the majority of the tests not included in the report)	Laidlaw reports 63 active buses with Caterpillar 3208 engines, dating from 1983 to 1995, almost all with Thomas bodies
1985 Crown Supercoach, 15 rows, Detroit Diesel 671 engine (HE2)	Laidlaw reports 44 active buses with Detroit Diesel 671 engines, almost all with Crown bodies, ranging in age from 1976 to 1990
1993 Thomas Saf-T-Liner, 13 rows, Caterpillar 3116 engine (RE2)	Laidlaw reports 69 active school buses with Caterpillar 3116 engines, almost all with Thomas bodies, ranging in age from 1988 to 1994
1998 Thomas Saf-T-Liner, 14 rows, Cummins 250 HP 8.3 liter engine (RE1)	Laidlaw reports 89 active school buses with Cummins 8.3 liter engines, including several with Thomas bodies, ranging in age from 1989 to 2001

20. Since over 200 of Laidlaw’s active buses are very similar or identical to those tested in the CARB Study, the emissions and self-pollution levels on Laidlaw’s buses should be included within the range of results measured by CARB.

21. As noted in Prof. Behrentz’s declaration, the CARB Study reported that “self-pollution from the bus’s own exhaust was found to play a significant role in on-board bus concentrations, especially when the windows were closed,” and that “intrusion was detected in all buses.” (CARB Study, p. 1 (Ex. B to Behrentz Dec.))

Self-Pollution Measurements

22. In the Behrentz article, “Measuring Self-Pollution in School Buses Using a Tracer Gas Technique” (Ex. C to Behrentz Dec.), researchers from the University of California Los Angeles calculated the approximate level of black carbon on the school bus resulting from self-pollution. The calculations were performed on one of the buses exhibiting a

1 representative low-level of self-pollution (a 1993 bus, with a self-pollution percentage of
2 0.03%). The researchers calculated the concentration of black carbon inside the cabin
3 due to the bus's own exhaust to be approximately $5 \mu\text{g}/\text{m}^3$, compared to a total amount of
4 black carbon measured on the bus of $10 \mu\text{g}/\text{m}^3$. (Id. p. 3743)

5 23. As discussed in Prof. Behrentz's declaration, the University of California at Berkeley and
6 the Natural Resources Defense Council measured in-cabin school bus black carbon
7 concentrations and reached very similar results to the CARB study (Prof. Behrentz was a
8 lead researcher in the CARB study). The researchers found levels of black carbon up to
9 four times higher on a 1986 school bus (with windows closed) than in a passenger car
10 immediately ahead of the bus. The average black carbon concentration on this 1986 bus
11 was about $19 \mu\text{g}/\text{m}^3$, while the concentration in the car averaged $6 \mu\text{g}/\text{m}^3$ – a difference of
12 $13 \mu\text{g}/\text{m}^3$. (Solomon, et al., "No Breathing in the Aisles: Diesel Exhaust Inside School
13 Buses," p. 8 (2001) (Ex. N to Behrentz Dec.)) This study found variability among buses
14 tested. For example, one test of 1987 bus found black carbon levels of $8 \mu\text{g}/\text{m}^3$, while the
15 background concentration in the car ahead was $7 \mu\text{g}/\text{m}^3$ – a difference of $1 \mu\text{g}/\text{m}^3$. (Id., p.
16 9)

17 24. A study conducted by Prof. J. Borak of Yale University School of Medicine equipped
18 two school buses with side-by-side Aethalometers (the same setup used in the CARB
19 Study and UCB/NRDC Study) and NIOSH 5040 Method samplers. Samples were taken
20 while the buses ran on a test track free from all emission sources other than self-pollution.
21 Using NIOSH Test Method 5040, Prof. Borak measured in-cabin elemental carbon levels
22 of $4.3 \mu\text{g}/\text{m}^3$. (Borak, et al., p. 264 (Ex. P to Behrentz Dec.)). Using the elemental
23 carbon to DPM conversion factor (1.56) discussed in Paragraph 18, the self-pollution
24 DPM levels inside the bus from Prof. Borak's study were about $6.7 \mu\text{g}/\text{m}^3$.

25 25. The published literature establishes that black carbon levels on school buses resulting
26 from self-pollution range from roughly $1 \mu\text{g}/\text{m}^3$ to $13 \mu\text{g}/\text{m}^3$. These black carbon
27 concentrations can be converted to DPM using the conversion factor of 2.04 as discussed

1 in Paragraph 18 above. Similarly, the elemental carbon levels measured in Prof. Borak's
2 study can be converted to DPM levels by multiplying the values by 1.56 (see Paragraph
3 18). Thus, the concentrations of self-pollution DPM inside school buses reported in the
4 published literature range from about 2 $\mu\text{g}/\text{m}^3$ to over 26 $\mu\text{g}/\text{m}^3$, depending on bus model
5 and age.

6 **Modeling of Diesel Bus Exhaust Self-Pollution**

7 26. Diesel self-pollution levels on Laidlaw's buses can also be calculated using emission
8 factors and a standard indoor air quality modeling equation. In addition to an emission
9 factor for DPM, the bus interior volume (in cubic meters), the exchange rate between
10 outside and inside air, and the self-pollution fraction are required for this calculation
11 method. The air concentration calculation equation has the form:

12 $C(t) = S/Q * (1 - \exp(-Qt/V))$, where:

13 $C(t)$ is the air concentration at time (t) in $\mu\text{g}/\text{m}^3$;

14 S is the in-cabin DPM emission factor in $\mu\text{g}/\text{hour}$ (adjusted to account for the self-
15 pollution fraction of the exhaust);

16 Q is the air flow rate in m^3/hr (equal to the air exchange rate (per hour) multiplied by the
17 bus interior volume V in m^3);

18 And V is the bus interior volume in m^3 .

19 27. Modeling of air concentrations is considered an accurate method to determine exposures
20 that occur over a wide-range of emission and dilution conditions. For example, modeling
21 may be more appropriate than monitoring if monitoring takes place during conditions not
22 representative of typical engine operations or environment. Air modeling is typically
23 used to determine exposures by the California Air Resources Board and the U.S.
24 Environmental Protection Agency, and I have exclusively used such calculations in well
25 over 100 Proposition 65 cases. In this matter, the modeling results can be confirmed by
26 monitoring data, which provides a best-case scenario.

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- 1 28. Modeling of air concentrations has been used in Proposition 65 cases since 1990. In one
2 of the first Proposition 65 matters, *People of the State of California v. Santa Maria Chili*
3 (in which I testified as an expert witness), air modeling was established as an appropriate
4 approach for calculating air concentrations, and does not have some of the drawbacks
5 inherent with monitoring data. In a declaration from John Vimont, EPA Region IX
6 Regional Meteorologist: “Monitoring data suffers from a number of limitations. One of
7 the primary limitations is that any given monitor can only measure what is happening at
8 the location where the monitor is physically located and at the time it is operating.”
9 (Declaration of John C. Vimont, *People of the State of California v. Santa Maria Chili*,
10 November 30, 1990, p. 8 (Ex. F)) Modeling overcomes this limitation by being able to
11 assess conditions that are impractical, impossible, or overly-expensive to monitor.
- 12 29. I assessed interior bus air concentrations using dimensions of an 84-passenger flat-nosed
13 Type D buses. (Department of Transportation, “Large School Bus Design Vehicle
14 Standards,” September 1998, Appendix A, p.48 (This document can be downloaded
15 from: <http://ntl.bts.gov/lib/10000/10600/10694/MBTC1054-1.pdf>)) This large bus has
16 the greatest interior volume of its class, which will result in lower calculated air
17 concentrations compared to a smaller bus with the same in-cabin DPM emission rate. I
18 calculated a bus interior volume of 53.1 m³, based on length of 11.93 meters, width of
19 2.31 meters, and height of 1.93 meters.
- 20 30. Research conducted at the University of British Columbia measured air exchange rates in
21 school buses ranging from 10.3 per hour (meaning that the air within the bus is replaced
22 with fresh air every 5.8 minutes) to 13.5 per hour (meaning that the air within the bus is
23 replaced with fresh air every 4.4 minutes). The mid-point of this range is about 12 air
24 exchanges per hour. (Bruaer, et al., *School Bus Air Quality* (July 3, 2000) (Ex. G))
- 25 31. The emission rate of DPM must be adjusted by the percentage of air inside the bus cabin
26 originating from the exhaust (self-pollution fraction). The CARB Study measured this
27 fraction using tracer gases, and found the value to range from 0.01% to 0.29%, depending

- 1 on the bus and window position (open or closed). A representative lower value of the
2 self-pollution fraction is about 0.03%. (CARB Study, p.105)
- 3 32. Using fixed values for bus interior volume ($V = 53.1 \text{ m}^3$), air exchange rate (12 hr^{-1}), time
4 ($t = 22.5$ minutes (0.38 hr , the mid-point of a 45-minute bus ride), and self pollution
5 fraction (0.03%), the range of calculated air concentrations within the bus will depend on
6 the DPM emission rate (in $\mu\text{g/hr}$). I calculated air concentrations using several DPM
7 emission rates, each based on different emission estimating techniques. The air flow rate
8 (Q) for this large bus is about $637 \text{ m}^3/\text{hr}$ ($Q = 53.1 \text{ m}^3 * 12 \text{ hr}^{-1}$).
- 9 33. The CARB Study calculated a black carbon emission rate of 0.128 g/min . (Id. at 104)
10 Converting to DPM (multiplying by 2.04), applying a self-pollution fraction of 0.03%,
11 and performing unit conversions yields an in-cabin DPM emission rate (S) of $4,700$
12 $\mu\text{g/hr}$. Solving the equation $C(t) = S/Q * (1 - \exp(-Qt/V))$ results in a DPM air
13 concentration within the bus of about $7.30 \mu\text{g/m}^3$.
- 14 34. Emission standards for particulate matter from diesel school buses have been set by the
15 U.S. EPA since 1988 (<http://www.epa.gov/cleanschoolbus/selecting.htm>). For years
16 prior to 1988, a typical emission rate was on the order of $1.0 \text{ gram/horsepower-hour}$
17 (g/bhp-hr).
- 18 a. Prior to Jan. 1, 1988: Unregulated
 - 19 b. Jan. 1, 1988 – Dec. 31, 1990: 0.6 g/bhp-hr
 - 20 c. Jan. 1, 1991 – Dec. 31, 1993: 0.25 g/bhp-hr
 - 21 d. Jan. 1, 1994 – Dec. 31, 2006: 0.1 g/bhp-hr
 - 22 e. Jan. 1, 2007 – present: 0.01 g/bhp-hr
- 23 35. As a representative example, applying the 1994 – 2006 emission standard of 0.1 g/bhp-hr ,
24 and assuming a 175 hp engine at 50% operating load, yields an in-cabin DPM emission
25 rate (S) of $2,625 \mu\text{g/hr}$. Solving the equation $C(t) = S/Q * (1 - \exp(-Qt/V))$ results in a
26 self-pollution DPM air concentration within the bus of $4.08 \mu\text{g/m}^3$. Analyzing Laidlaw's
27

- 1 California Vehicle Spreadsheet, I found that Laidlaw has 3,387 active buses that are
2 represented by this DPM calculation (model years 1994 – 2006).
- 3 36. Setting the emission rates at the year-correlated standard, buses of model-years 1991 –
4 1993 would be expected to have self-pollution DPM concentrations within the cabin 2.5
5 times higher than 1994 – 2006 buses, or about $10.2 \mu\text{g}/\text{m}^3$. Analyzing Laidlaw’s
6 California Vehicle Spreadsheet, I found that Laidlaw has 164 active buses that are
7 represented by this DPM calculation (model years 1991 – 1993).
- 8 37. And pre-1991 buses, with emission rates set at the year-correlated standard, would be
9 expected to have inside DPM concentrations 6 times higher than 1994 – 2006 buses, or
10 about $24.5 \mu\text{g}/\text{m}^3$ from self-pollution. Analyzing Laidlaw’s California Vehicle
11 Spreadsheet, I found that Laidlaw has 226 active buses that are represented by this DPM
12 calculation (model years 1990 and earlier).
- 13 38. These results compare favorably to the self-pollution levels measured in the monitoring
14 studies referenced above.
- 15 39. The California Air Resources Board measured pollutant emissions from a fleet of San
16 Diego School District buses using BP Emission Control Diesel (ECD) fuel. (CARB, BP
17 ECD Demonstration Program, December 7, 2000, p.5. (Ex. H)) This study measured
18 particulate matter emissions of 0.19 g/mile using BP ECD fuel, and 0.22 g/mile using
19 CARB diesel fuel. Applying an emission factor of 0.19 g/mile and assuming an average
20 route speed of 25 mi/hour (comprising both city and suburban driving) yields an in-cabin
21 DPM emission rate (S) of 1,425 $\mu\text{g}/\text{hr}$. Solving the equation $C(t) = S/Q * (1 - \exp(-Qt/V))$
22 results in an in-cabin DPM air concentration from self-pollution of about $2.21 \mu\text{g}/\text{m}^3$.
- 23 40. DPM emission rates have also been estimated using bus exhaust opacity measurements.
24 The correlation between opacity readings (in percent) to DPM emissions (in g/mile)
25 depends on many variables, including how the opacity measurements were taken, and the
26 driving conditions being simulated. For example, correlations between opacity percent
27 and DPM emissions are different for opacity measurements made for wide-open throttle

1 (acceleration), wide-open throttle (neutral), and cruising modes. (Broderick, Christie-Joy
2 (UC Davis), Daniel Sperling (UC Davis), and Christopher S. Weaver (Engine, Fuel, and
3 Emissions Engineering), Multiple Smoke Opacity Measurements as Indicators of
4 Particulate Emissions for Heavy-Duty Diesel Vehicle Inspection and Maintenance
5 Programs, University of California Transportation Center Report 421, Fall 2000. (Ex. I))

6 41. I reviewed measurements from Laidlaw's snap-idle opacity tests, which are comparable
7 to wide-open throttle (neutral) mode opacity analyses in the Broderick study. (Id., p.5)
8 Measurements for 1988 – 1990 model year buses show that wide-open throttle (neutral)
9 opacity readings of five percent have DPM emission rates of at least 2.0 g/mile. (Id.,
10 Figure 2) The DPM emission rate associated with these opacity levels is over 10 times
11 higher than the 0.19 g/mile DPM level discussed in Paragraph 39 above. Since a DPM
12 emission rate of 0.19 g/mile results in a modeled in-cabin DPM air concentration from
13 self-pollution of 2.21 $\mu\text{g}/\text{m}^3$, the corresponding concentration from a DPM emission rate
14 of 2.0 g/mi will be roughly 23.2 $\mu\text{g}/\text{m}^3$. The snap-idle opacity measurements made for
15 Laidlaw's California bus fleet identified at least 664 active buses with readings greater
16 than or equal to five percent.

17 **Comparison with Proposition 65 No Significant Risk Level Warning Requirements**

18 42. For Proposition 65 listed carcinogens, such as DPM, it is necessary to verify whether
19 exposure levels exceed what is called the "No Significant Risk Level," or NSRL. The
20 California Office of Environmental Health Hazard Assessment (OEHHA) characterizes
21 the NSRL in this way: "The NSRL is the daily intake level calculated to result in one
22 excess case of cancer in an exposed population of 100,000, assuming lifetime (70-year)
23 exposure at the level in question." (California Office of Environmental Health Hazard
24 Assessment, Proposition 65 Safe Harbor Levels: No Significant Risk Levels for
25 Carcinogens and Allowable Dose Levels for Chemicals Causing Reproductive Toxicity,
26 August 2006, p. 1. (Ex. J) and Title 22, California Code of Regulations, Section
27

1 12703(b)) The one in 100,000 NSRL for cancer risk is often expressed as 10 per million;
2 nevertheless, the meaning is identical.

3 43. A basic step in verifying whether self-pollution DPM exceeds the Proposition 65 NSRL
4 is to determine the air concentration that equals the NSRL intake. DPM air
5 concentrations that exceed this level will be subject to warnings under Proposition 65.
6 (California Health and Safety Code, §25249.10) The required parameters and
7 calculations for this assessment include:

- 8 • Bus ride duration (hr);
- 9 • A body-weight adjusted inhalation rate ($\text{m}^3/\text{kg}\cdot\text{hr}$);
- 10 • The annual-average daily dose to DPM ($\text{mg}/\text{kg}\cdot\text{day}$);
- 11 • The cancer potency slope for DPM ($\text{mg}/\text{kg}\cdot\text{day}$)⁻¹.

12 These parameters and associated calculations are discussed below.

13 44. I have been provided with an extensive review of Laidlaw's bus routes in California that
14 indicates the average school bus ride is 45 minutes in each direction, or a total of 1.5
15 hours each day. This finding is consistent with the United States' Environmental
16 Protection Agency's conclusion that the average student spends an hour and half each
17 weekday in a school bus. (US EPA, Clean School Bus USA, (Ex. K)) It is reasonable to
18 assume that a child will spend 180 days per year on a school bus, with an average daily
19 exposure of 90 minutes. This 1.5 hour period includes both morning and after-school bus
20 trips. The annual exposure duration from this scenario is about 270 hours (the amount of
21 time a child spends inside the school bus per year).

22 45. Inhalation rates are usually reported in units of air volume per time; i.e., liters/minute or
23 cubic meters/day. The inhalation rate is used, in conjunction with the DPM air
24 concentration, to quantify the dose the child will inhale during a given period of time.
25 Dose, as used in excess cancer risk calculations, typically has units of $\text{mg}/\text{kg}\cdot\text{day}$, or
26 mass (mg) of DPM inhaled per day for each kg of body weight. For Proposition 65
27 cancer risk warning calculations, this dose is usually averaged over one year of exposure.

1 In other words, a yearly dose in mg/kg-year is calculated, and then divided by 365 days
2 per year to arrive at an annual-average daily dose in mg/kg-day.

3 46. OEHHA has developed children's inhalation rates adjusted for body weight, which is
4 ideally suited for calculating dose. For children 12 years or younger, OEHHA developed
5 inhalation rates in liters/kg-day and presented them as percentiles for the population
6 studied. I used the 75th percentile inhalation rate of 489.5 liters/kg-day, which equates to
7 0.0204 m³/kg-hr. (OEHHA, Air Toxics Hot Spots Risk Assessment Guidelines, Part IV,
8 September 2000, Table 3.20 (This document can be downloaded from:
9 http://www.oehha.ca.gov/air/hot_spots/pdf/Stoch4f.pdf))

10 47. As a starting point in calculating the annual-average daily dose, I assume an arbitrary
11 DPM air concentration of 1.0 µg/m³. The arbitrary value of 1.0 µg/m³ will be adjusted in
12 the final step, which is the calculated level at which the excess cancer risk is 10 per
13 million for the given inhalation rate and exposure duration.

14 48. The yearly inhalation dose of DPM is:

$$15 \quad 1.0 \mu\text{g}/\text{m}^3 * 270 \text{ hr}/\text{yr} * 0.0204 \text{ m}^3/\text{kg}\text{-hr} * \text{mg}/1000 \mu\text{g} = 5.508\text{E-}03 \text{ mg}/\text{kg}\text{-yr}.$$

16 The annual-average daily inhalation dose of DPM is:

$$17 \quad 5.508\text{E-}03 \text{ mg}/\text{kg}\text{-yr} * \text{yr}/365 \text{ day} = 1.509\text{E-}05 \text{ mg}/\text{kg}\text{-day}.$$

18 An inhalation retention factor of 100% is assumed, making dose and intake equivalent.

19 49. A cancer potency slope, with units of inverse dose ((mg/kg-day)⁻¹), is used to convert
20 dose to a unitless value of excess cancer risk. For DPM, OEHHA and CARB have
21 identified a cancer potency slope of 1.1 (mg/kg-day)⁻¹. (Ex. B)

22 50. Calculating the Proposition 65 cancer risk is a multiplication of the annual-average daily
23 dose times the potency slope. For a DPM air concentration of 1.0 µg/m³, the calculated
24 excess cancer risk equals:

$$25 \quad 1.509\text{E-}05 \text{ mg}/\text{kg}\text{-day} * 1.1 \text{ (mg}/\text{kg}\text{-day)}^{-1} = 16.60 \text{ per million}.$$

26 51. Next, I calculate the DPM air concentration resulting in a 1 in 100,000 (10 per million)
27 excess cancer risk:

1 $1.0 \mu\text{g}/\text{m}^3 / 16.60 \text{ per million risk} = X / 10 \text{ per million risk}$

2 Solving for X, a DPM air concentration of $0.60 \mu\text{g}/\text{m}^3$ will cause a Proposition 65 excess
3 cancer risk of 10 per million. This calculation is based on the exposure duration and
4 inhalation rates presented above. In essence, for exposure duration of 270 hours/year,
5 and a child's inhalation rate of $0.0204 \text{ m}^3/\text{kg}\cdot\text{hr}$, bus self-pollution DPM air
6 concentrations that exceed $0.60 \mu\text{g}/\text{m}^3$ will require a warning under Proposition 65.

7 Using the black carbon to DPM conversion factor of 2.04, it follows that a black carbon
8 air concentration of about $0.30 \mu\text{g}/\text{m}^3$ will result in a Proposition 65 excess cancer risk of
9 10 per million.

- 10 52. The resultant cancer risk calculation is proportional to DPM air concentration, exposure
11 duration, and inhalation rate. Changes or variability in any of these values will linearly
12 affect the calculated cancer risk value. For example, doubling the exposure duration will
13 double the excess cancer risk; reducing the black carbon or DPM air concentration by a
14 factor of two will halve the excess cancer risk.

15 **Concluding Statements**

- 16 53. The DPM self-pollution inside a given bus cabin will depend on the make and model of
17 the bus engine, age and condition of the engine, and whether the passenger windows are
18 open or closed. Levels of DPM equal to about $0.60 \mu\text{g}/\text{m}^3$, or a black carbon
19 concentration of $0.30 \mu\text{g}/\text{m}^3$, will cause a Proposition 65 excess cancer risk of 10 per
20 million.
- 21 54. Relying upon the modeling calculations set forth above in Paragraphs 34 through 38
22 (with emission rates set at the year-correlated standard), I calculate the following:
- 23 a. Laidlaw's 3,387 active buses with model years of 1994 – 2006 expose passengers to self-
24 pollution DPM at a level ($4.08 \mu\text{g}/\text{m}^3$) that results in a Proposition 65 excess cancer risk
25 of about 68 per million;
- 26
27

- 1 b. Laidlaw's 164 active buses with model years of 1991 – 1993 expose passengers to self-
2 pollution DPM at a level ($10.2 \mu\text{g}/\text{m}^3$) that results in a Proposition 65 excess cancer risk
3 of approximately 169 per million;
- 4 c. Laidlaw's 226 active buses with model years of 1990 or earlier expose passengers to self-
5 pollution DPM at a level ($24.5 \mu\text{g}/\text{m}^3$) that results in a Proposition 65 excess cancer risk
6 of approximately 407 per million.
- 7 55. The concentrations of DPM from self-pollution monitored inside school buses, ranging
8 from about $2 \mu\text{g}/\text{m}^3$ to over $26 \mu\text{g}/\text{m}^3$, would result in Proposition 65 excess cancer risks
9 of approximately 33 to 433 per million. And in-cabin DPM air concentrations from self-
10 pollution calculated through modeling, ranging from about $2.21 \mu\text{g}/\text{m}^3$ to $24.5 \mu\text{g}/\text{m}^3$,
11 would result in Proposition 65 excess cancer risks of approximately 37 to 407 per
12 million.
- 13 56. All of the studies I reviewed, and the calculations I made, show that school bus self-
14 pollution DPM levels exceed the Proposition 65 No Significant Risk Level of 10 per
15 million. While no one study is definitive alone, the ensemble of evidence leads me to
16 conclude that school buses of model years 2006 or older, unless they have been
17 retrofitted with DPM emission controls to bring them to 2007 standards, will require
18 warnings under Proposition 65.

19 //

20 I declare under penalty of perjury under the laws of the State of California that the
21 foregoing is true and correct. Executed this 9th day of May, 2007, at Ojai, California.

22
23 _____
24 Camille Sears

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Proof of Service

I am employed in the County of San Mateo, California. I am over the age of 18 and not a party to this action. My business address is 601 Gateway Blvd., Suite 1000, South San Francisco, California, 94080.

On May ____, 2007, I served the foregoing document described as:

DECLARATION OF CAMILLE SEARS, M.S., IN SUPPORT OF PLAINTIFFS' MOTION FOR SUMMARY ADJUDICATION

on the parties listed below by US First Class Mail or other manner (as noted):

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I declare under penalty of perjury of the laws of the California that the foregoing is true and correct and that this was executed on May ____, 2007 in South San Francisco, California.

Bonnie Heeley