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MEMORANDUM

May 1, 2001

TO: Mike Brady, David Ipps
CC: Deb Niemeier, Dan Chang, Tom Kear
FROM: Douglas Eisinger (707-665-9900)

SUBJECT: Recent Mobile Source Air Toxics Information

This memo includes important information from two recent mobile source air toxics actions: publication of the U.S. Environmental Protection Agency's (EPA) Final Rulemaking on the "Control of Emissions of Hazardous Air Pollutants from Mobile Sources," and release of a San Francisco Bay Area Air Toxics study by the Bay Area Air Quality Management District (BAAQMD). Publication of EPA's final rule and release of the Bay Area report both occurred on March 29, 2001. Findings from both studies may be useful for project analyses and to help respond to various requests for information related to mobile sources and air toxics. This memorandum includes six sections: (1) a summary of important findings, (2) recommendations for Caltrans, (3) discussion of the EPA rulemaking, (4) discussion of the BAAQMD report, (5) an appendix with background information concerning diesel risk, and (6) an appendix with a two-page draft information resource for Caltrans district staff.

1.0 SUMMARY OF IMPORTANT FINDINGS

Both the EPA final rule and the Bay Area study document significant declines in mobile source air toxic emissions. The Bay Area report documents a 40% decline in toxics emissions from 1994 to 1999. The EPA final rule forecasts that by the year 2020, mobile source toxic emissions will have declined between 67% and 94%, depending upon the pollutant. Both EPA and the BAAQMD identify approximately a half dozen pollutants as being particularly important. The BAAQMD estimates that 1,3-butadiene, benzene, formaldehyde, and diesel exhaust particulate matter (PM) are responsible for more than 90% of the potential excess cancer risk associated with urban air toxics. EPA documents that the following substances are important from a public health perspective:

- Diesel PM + diesel exhaust organic gases (DPM + DEOG)
- Benzene
- 1,3-butadiene
- Formaldehyde
- Acetaldehyde
- Acrolein

2.0 RECOMMENDATIONS

Caltrans should actively follow, comment on, and, if necessary, supplement EPA research efforts underway in anticipation of EPA's July 1, 2003 proposed rulemaking. Caltrans should focus on EPA's "hot spot" research efforts, and should assess whether EPA research will be applicable to and properly represent California conditions.

Caltrans should consider distributing to its district staff a summary of the recent EPA and BAAQMD information. The information could improve documentation of potential air toxics impacts associated with transportation projects. A draft "Air Toxics Update for Caltrans District Offices" is included as an appendix.

3.0 EPA FINAL RULEMAKING: "CONTROL OF EMISSIONS OF HAZARDOUS AIR POLLUTANTS FROM MOBILE SOURCES"

On March 29, 2001, EPA published "Control of Emissions of Hazardous Air Pollutants from Mobile Sources; Final Rule," referred to in the rest of this memo as the "EPA Final Rule" (EPA, 2001). (Text of the EPA Final Rule is available via the Internet at <http://www.epa.gov/otaq/regs/toxics/toxicfrm.pdf>.) The EPA Final Rule

1. Identifies 21 mobile source toxics of concern.
2. Documents expected future reductions in on-road toxics emissions.
3. Requires gasoline refiners to produce fuels that continue to achieve the toxics reductions achieved to date (to date, refiners have over-controlled toxics in gasoline; the rulemaking requires refiners to continue that practice).
4. Describes a "Technical Analysis Plan" (TAP) to continue toxics evaluations.
5. Commits EPA to a future rulemaking (July 1, 2003 for a proposal; July 1, 2004 for a final rulemaking) at which time additional controls will be considered.

Of greatest importance to Caltrans are: (a) EPA documentation that MSATs of concern are a limited set of substances, (b) EPA's and BAAQMD's documentation that mobile source toxic emissions are declining substantially, and (c) EPA's continued work to measure and evaluate emissions, exposure, and risk related to mobile source toxics.

Pollutants of Concern

EPA identifies 21 Mobile Source Air Toxics (MSATs). EPA states the list is appropriate for both on-road and nonroad mobile sources. Table 1 includes the EPA MSATs.

Table 1. MSATs listed in EPA's Final Rule.

1. Acrolein	8. Dioxin/Furans	15. MTBE
2. Acetaldehyde	9. Ethylbenzene	16. Naphthalene
3. Arsenic Compounds	10. Formaldehyde	17. Nickel Compounds
4. Benzene	11. n-Hexane	18. POM (polycyclic organic matter)
5. 1,3-Butadiene	12. Lead Compounds	19. Styrene
6. Chromium Compounds	13. Manganese Compounds	20. Toluene
7. DPM+DEOG	14. Mercury Compounds	21. Xylene

Source: EPA Final Rule, Table II-1.

The final rulemaking differs from the notice of proposed rulemaking (NPRM) in that diesel exhaust has been identified more specifically as diesel PM and diesel exhaust organic gases. The two components of diesel exhaust are meant to serve as a single pollutant listing.

EPA went through a comprehensive process to identify candidate compounds for its MSAT list. EPA states:

“It is important to note that inclusion on the list is not itself a determination by EPA that emissions of the compound in fact present a risk to public health or welfare, or that it is appropriate to adopt controls to limit the emissions of such a compound from motor vehicles or their fuels. The purpose of the list is to provide a screening tool that identifies those compounds emitted from motor vehicles or their fuels for which further evaluation of emissions controls is appropriate.” [EPA Final Rule, p. 17234(c).]

EPA acknowledges there are “...hundreds of different compounds and elements that are known to be emitted from passenger cars, on-highway trucks, and various types of nonroad equipment” (EPA Final Rule, p. 17233(b)). EPA compared vehicle emissions to four lists of toxic air pollutants to identify substances of concern. The four lists used in the comparison included hazardous air pollutants listed in Clean Air Act’s section 112(b), California’s Toxic Air Contaminant (TAC) list, the U.S. Department of Health and Human Services’ Agency for Toxic Substances and Disease Registry (ATSDR) list of Minimal Risk Levels, and the International Agency for Research on Cancer’s monographs on cancer (EPA Final Rule, p. 17237(a)). EPA eliminated all but 21 substances from further control measure evaluation.

EPA’s rulemaking also includes an analysis of the relative importance of mobile source emissions to other sources of toxic substances such as stationary and area sources. EPA found that mobile sources were a significant contributor to only a subset of 21 MSATs. **Table 2** summarizes EPA’s assessment of the contribution mobile sources make to total emissions for the 21 MSATs. As documented in Table 2, EPA estimates that, in 1996, on-road mobile sources contributed more than 10% of the emissions for 12 of the 21 substances. Greater than 95% of emissions are due to sources other than on-road motor vehicles for 8 of the 21 MSATs; EPA had no data for one substance (naphthalene).

The percentage contribution of mobile sources presented in Table 2 is based on 1996 emissions estimates. As discussed below, EPA forecasts substantial future reductions in on-road mobile source air toxic emissions.

Given current emissions, expected emissions reductions, health hazards associated with individual compounds, and exposure from on-road sources, EPA believes that six MSATs present the greatest potential risk to public health in the future (EPA Final Rule, p. 17257(c)):

1. Diesel PM and Diesel exhaust organic gases (DPM + DEOG)
2. Benzene
3. 1,3-butadiene
4. Formaldehyde
5. Acetaldehyde
6. Acrolein

Table 2. Percent contribution from mobile sources for 21 air toxics of concern (1996 emissions).

Toxic Substance	Percent Total Emissions (mobile, stationary, area, other)		
	On-Road Mobile	Nonroad Mobile	All Mobile
1. Toluene	51	23	74
2. Benzene	48	28	76
3. MTBE	47	39	86
4. ethylbenzene	47	37	84
5. xylene	43	36	79
6. 1,3-butadiene	42	18	60%
7. Acetaldehyde	29	41	70%
8. Diesel PM	About one third	About two thirds	Almost all
9. styrene	33	7	40
10. n-hexane	26	18	44
11. formaldehyde	24	25	49
12. acrolein	16	23	39
13. POM (polycyclic organic matter)	4	2	6
14. nickel compounds	0.9	7.6	8.5
15. lead compounds	0.8	21.8	22.6
16. manganese compounds	0.2	1.3	1.5
17. mercury compounds	0.1	4.1	4.2
18. naphthalene	NA	NA	NA
19. dioxins/furans	0.2	NA	0.2
20. chromium compounds	1.2	3	4.2
21. arsenic compounds	0.06	0.51	0.57

Source: EPA Final Rule, pp. 17238-17239.

Expected Future Emissions Reductions and Reformulated Gasoline Requirements

EPA estimates that existing motor vehicle and fuel control programs will reduce emissions through the year 2020. EPA (Final Rule, p. 17241, Table III-4) cites expected on-road emissions reductions, from 1990 to 2020, of

- 94% for diesel PM
- 76% for formaldehyde
- 73% for benzene
- 72% for 1,3-butadiene
- 67% for acetaldehyde
- 67% for MTBE
- 72% for VOC

EPA also notes that it expects the trend for other gaseous MSATs such as acrolein, POM, styrene, xylene, toluene, ethylbenzene, naphthalene, and n-hexane to follow the trend for VOC, since the substances are all VOCs (EPA Final Rule, p. 17240(b)).

Much of the success in reducing MSATs is credited to the Clean Air Act's reformulated gasoline (RFG) program, which identified five toxics for control: benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and POM (EPA Final Rule, p. 17247). The federal program is required in several California areas, including Los Angeles, Sacramento, and San Diego. California has implemented its own RFG program, which the California Air Resources Board documents as satisfying federal RFG requirements (ARB, 2001). The current California RFG program has been in place since 1996 and will continue through 2002. California Phase 3 RFG begins 2003. Phase 3 will eliminate the use of MTBE in California gasoline. EPA has found the Phase 3 program to be more stringent than Phase 2 (EPA Final Rule, p. 17252(c)).

EPA Technical Analysis Plan

EPA plans continued MSAT research and analysis, to be conducted as part of a Technical Analysis Plan (TAP). The TAP will address four areas (EPA Final Rule, p. 17258(a)):

1. Develop better emission factors for nonroad sources.
2. Improve air toxics exposure estimates for microenvironments.
3. Improve consideration of range of total public exposures to air toxics.
4. Increase understanding of the cost-effectiveness of various control options.

Based on research findings, EPA will propose another MSAT rulemaking on July 1, 2003, which could include recommended additional control measures.

Of greatest interest to Caltrans is EPA's planned work to improve estimation of exposure in microenvironments, and consideration of total public exposure. EPA progress in these areas includes (EPA Final Rule pp. 17258-17259):

1. Development of the Hazardous Air Pollutant Exposure Model—Version 4 (HAPEM4), to estimate microenvironmental exposure. HAPEM4 is currently undergoing peer review and will be revised based on comments.
2. On-going studies to evaluate indoor and outdoor concentrations of various pollutants. These studies include efforts planned or underway to assess personal exposure in various settings, such as in commercial buildings near heavily trafficked roadways.
3. Planned consideration of the “disproportionate impacts of air toxics in hot spot areas.” EPA actions include current work to develop local-scale emissions and dispersion models for mobile sources to “better inform the Agency and the public about potential hot spots.” EPA is also conducting spatially refined urban area modeling, including mobile sources.
4. Field sampling studies to support “real world” characterizations of a few typical hot spot areas.

EPA notes that state and local air pollution control agencies have raised the hot spot issue as a “major concern that needs to be addressed in a comprehensive air toxics risk characterization.”

4.0 BAY AREA MARCH 2001 REPORT (BASED ON 1999 DATA)

In March 2001, the Bay Area Air Quality Management District (BAAQMD) announced the publication of their “Toxic Air Contaminant Control Program Annual Report 1999” (BAAQMD, 2001). The BAAQMD study documents a significant decline in air toxics problems, including those related to motor vehicles. The report documents a 40% reduction in air toxics cancer risk during the 1994 to 1999 time period. BAAQMD estimates 186 excess cancers per million people exposed to air toxics in 1999, compared to 315 excess cancers estimated in 1994. The decline is related to factors contributing to statewide improvements, so the findings are not unique to the Bay Area. Much of the reduced risk is attributed to reformulated gasoline use, beginning in 1996, which dramatically reduced benzene and 1,3-butadiene emissions. (A copy of the press announcement is available from the Internet; see: <http://www.baaqmd.gov/pie/press/toxics01.pdf>. The BAAQMD report is also available from the Internet: <http://www.baaqmd.gov/permit/toxics/report.htm>; select the 1999 report.)

Mobile sources are the most significant source of air toxics as reported by the BAAQMD. A little more than 60% of the cancer risk (61.7%) is due to two substances: 1,3-butadiene and benzene (see Table 4, page 23); both substances are primarily emitted by mobile sources. Formaldehyde exposure, related substantially to mobile source emissions, was estimated to be responsible for approximately 9% of the excess cancer risk. The other major pollutant-specific risks are from compounds emitted primarily by stationary sources.

The Bay Area report briefly mentions the risk associated with diesel exhaust, although the report acknowledges that diesel PM risk can exceed the combined risk of all other substances (p. 12). In a brief passage, the BAAQMD report says that in comparison to the 186 excess cancers per million from other air toxics, diesel PM may be responsible for 450 excess cancers per million (based on ARB & OEHHA work). Diesel PM emissions are therefore approximately 2.4 times more important than the emissions of other toxic substances. Another way of viewing relative importance is to state that diesel would be responsible for about 70% of the total risk, since the 450 diesel-related excess cancers represent about 70% of the total risk of combining diesel-related cancers (450) with cancers associated with other urban air toxics (186). The report’s main message of a 40% reduction in air toxics risk is independent of diesel-related risks, although BAAQMD staff expect substantial future reductions in diesel-related risk, given the state’s existing diesel control program (Bateman, 2001).

5.0 REFERENCES

- ARB, 2001. "Comparison of Federal and California Reformulated Gasoline." Formerly, California RFG Fact Sheet Number 3. Prepared by the California Air Resources Board. Accessed via the Internet: http://www.arb.ca.gov/cbg/pub/cbg_fs3.htm. Last accessed May 1.
- BAAQMD, 2001. "Toxic Air Contaminant Control Program Annual Report 1999." Prepared by the Bay Area Air Quality Management District. March 29. Accessed via the Internet: <http://www.baaqmd.gov/permit/toxics/report.htm>. Last accessed April 12.
- Bateman, B., 2001. Personal communication between B. Bateman, Bay Area Air Quality Management District, and Douglas Eisinger, U.C. Davis / Caltrans Air Quality Project. April 16.
- EPA, 2001. "Control of Emissions of Hazardous Air Pollutants from Mobile Sources; Final Rule," U.S. Environmental Protection Agency. Federal Register, Vol. 66, No. 61, pp. 17230-17273. March 29.

APPENDIX ONE: DIESEL RISK DISCUSSION

Air toxics issues are relatively recent in terms of regulatory review and action, and it is important to keep in mind how the relative importance of different compounds might differ with different assumptions or new information. Currently, California air toxics studies such as the Bay Area findings and recent work in Los Angeles (the MATES-II study) show exposure to diesel exhaust to be responsible for some 70% to 80% or more of total urban air toxics risk. The relative importance of diesel is predicated on unit risk factors established by California's Office of Environmental Health Hazard Assessment (OEHHA). Any change to the diesel unit risk factor, for example due to new scientific findings, could substantially alter the relative importance of diesel emissions vs. emissions of other mobile source toxics.

Background information on California's diesel unit risk factors vs. those of other organizations helps illustrate that the scientific community is still working to reduce the uncertainty associated with risk from diesel exhaust. OEHHA's unit risk factor for diesel PM exposure is 3.0×10^{-4} . OEHHA's unit risk estimate means for a lifetime (70 years) of exposure to $1.0 \mu\text{g}/\text{m}^3$ of diesel PM, 300 excess cancers per million people exposed are expected. Earlier (1990s) draft materials by EPA included a draft diesel exhaust unit risk factor about 18 times lower than OEHHA's, (1.7×10^{-5}), although recent EPA documents say the data are too uncertain to create a unit risk. EPA's most recent diesel risk report (see: <http://www.epa.gov/ncea/pdfs/diesel/ch9final.pdf>, p. 9-22) includes a discussion of the uncertainty in establishing a unit risk factor. The World Health Organization (WHO) has estimated a diesel exhaust excess cancer unit risk factor of $1.6 - 7.1 \times 10^{-5}$ (about 7 times lower than the unit risk estimated by OEHHA) (source: WHO 1999 Air Quality Guidelines, p. 56; see: http://www.who.int/environmental_information/Air/Guidelines/aqguide3.pdf).

The importance of the selection of the unit risk factor becomes apparent when used with the Bay Area as a case study to compare risk results using OEHHA's and WHO's risk factors. With OEHHA's unit risk for diesel exhaust, the BAAQMD estimates 450 excess cancers per million people and 70% of total air toxics risk attributable to diesel. With the WHO unit risk factor, this estimate would drop to about 64 excess cancers per million and about 25% of the total risk due to diesel exhaust.

Control of diesel exhaust has become a primary objective of ARB and EPA. Much of California's regulatory focus is driven by the listing of diesel PM exhaust as a TAC, and by the relative importance of diesel PM exhaust in contributing to air toxics-related risk. The relative importance of diesel exhaust compared to other compounds is a function, however, of the unit risks assigned to diesel exposure. If the assumed unit risk factors change with improved scientific knowledge, it is possible that other mobile source air toxics will increase in relative importance.

EPA and ARB are taking significant steps to reduce risks associated with both diesel and non-diesel pollutants through the use of cleaner fuels and improved technology. Past progress is documented in the BAAQMD's March 29, 2001 publication: "Toxic Air Contaminant Control Program Annual Report 1999;" (see: <http://www.baaqmd.gov/permit/toxics/report.htm>; select the 1999 report). Expected future progress is documented in EPA's March 29, 2001 final mobile source air toxics rulemaking, "Control of Emissions of Hazardous Air Pollutants from Mobile Sources; Final Rule" (see: <http://www.epa.gov/otaq/regs/toxics/toxicfrm.pdf>).

APPENDIX TWO
DRAFT: “AIR TOXICS UPDATE FOR CALTRANS DISTRICT OFFICES”

Introduction

This update includes important information from two recent mobile source air toxics actions: publication of the U.S. Environmental Protection Agency’s (EPA) Final Rulemaking on the “Control of Emissions of Hazardous Air Pollutants from Mobile Sources,” and release of a San Francisco Bay Area Air Toxics study by the Bay Area Air Quality Management District (BAAQMD). Publication of EPA’s final rule and release of the Bay Area report both occurred on March 29, 2001. Findings from both studies may be useful for project analyses and to help respond to various requests for information related to mobile sources and air toxics.

Important Findings

Both the EPA Final Rule and the Bay Area study document significant declines in mobile source air toxic emissions. The Bay Area report documents a 40% decline in toxics emissions from 1994 to 1999. The EPA Final Rule forecasts that by the year 2020, mobile source toxic emissions will decline between 67% and 94%, depending upon the pollutant.

Pollutants of Concern

EPA identifies 21 Mobile Source Air Toxics (MSATs). EPA states the list is appropriate for both on-road and nonroad mobile sources. Table 1 includes the EPA MSATs.

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4. Benzene	11. n-Hexane	18. POM (polycyclic organic matter)
5. 1,3-Butadiene	12. Lead Compounds	19. Styrene
6. Chromium Compounds	13. Manganese Compounds	20. Toluene
7. Diesel PM + Diesel Exhaust Organic Gases (DPM+DEOG)	14. Mercury Compounds	21. Xylene

Source: EPA Final Rule, Table II-1, pp. 17235-17236.

The EPA final rulemaking identifies the toxic components of diesel exhaust as diesel particulate matter (PM) and diesel exhaust organic gases. The two components of diesel exhaust are meant to serve as a single pollutant listing.

EPA went through a comprehensive process to identify candidate compounds for its MSAT list. EPA states:

“It is important to note that inclusion on the list is not itself a determination by EPA that emissions of the compound in fact present a risk to public health or welfare, or that it is appropriate to adopt controls to limit the emissions of such a compound from motor vehicles or their fuels. The purpose of the list is to provide a screening tool that identifies

those compounds emitted from motor vehicles or their fuels for which further evaluation of emissions controls is appropriate.” [EPA Final Rule, p. 17234(c).]

EPA acknowledges that there are “...hundreds of different compounds and elements that are known to be emitted from passenger cars, on-highway trucks, and various types of nonroad equipment” (EPA Final Rule, p. 17233(b)). EPA’s process eliminated all but 21 of these compounds as meriting inclusion on a list of substances for which further emission control evaluation was appropriate.

Although EPA identifies 21 MSATs, EPA notes that the following six substances are important from a public health perspective:

1. Diesel particulate matter (PM) and diesel exhaust organic gases (DPM + DEOG)
2. Benzene
3. 1,3-butadiene
4. Formaldehyde
5. Acetaldehyde
6. Acrolein

Consistent with EPA, the BAAQMD identifies a brief list of substances that are especially important from a public health perspective. The BAAQMD estimates that in 1999, 1,3-butadiene, benzene, formaldehyde, and diesel exhaust particulate matter were responsible for more than 90% of the potential excess cancer risk associated with urban air toxics.

Expected Future Emissions Reductions and Reformulated Gasoline Requirements

EPA estimates that existing motor vehicle and fuel control programs will reduce emissions through the year 2020. EPA (Final Rule, p. 17241, Table III-4) cites expected on-road emissions reductions, from 1990 to 2020, of

- 94% for diesel PM
- 76% for formaldehyde
- 73% for benzene
- 72% for 1,3-butadiene
- 72% for VOC
- 67% for acetaldehyde
- 67% for MTBE

EPA also notes that it expects the trend for other gaseous MSATs such as acrolein, POM, styrene, xylene, toluene, ethylbenzene, naphthalene, and n-hexane to follow the trend for VOC, since the substances are all VOCs (EPA Final Rule, p. 17240(b)).

Much of the success in reducing MSATs is credited to the Clean Air Act’s (CAA) reformulated gasoline (RFG) program, which identified five toxics for control: benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and POM (EPA Final Rule, p. 17247). CAA RFG applies in several California areas, including Los Angeles, Sacramento, and San Diego. California has implemented its own RFG program, which the California Air Resources Board documents as satisfying federal RFG requirements. The current California RFG program has been in place since 1996 and will continue through 2002. California Phase 3 RFG (which eliminates the use of MTBE) begins 2003, and EPA has found the Phase 3 program to be more stringent than Phase 2 (EPA Final Rule, p. 17252(c)).