Appendix B

Technical Information on Operational Emissions Modeling

Appendix B
Technical Information for Operational Emissions Modeling[1]

This appendix provides additional information on the operational emissions modeling procedures for Alternative 2/3. Operational emissions for Alternatives 1 and 4 are discussed qualitatively in Chapter 4 as complete traffic data for these alternatives is not available.

B.1 Criteria Pollutant and CO_2 Emissions Modeling

The estimation of criteria pollutant and CO_2 emissions associated with Alternative 2/3 was conducted using Caltrans' CT-EMFAC model and vehicle activity data provided by the project traffic engineer, DKS (Fugitt pers. comm.).

CT-EMFAC is a California-specific project-level analysis tool developed for Caltrans by the University of California, Davis to model criteria pollutant, mobile source air toxic, and CO_2 emissions from on-road mobile sources. The model uses the latest version of the California Emission Factors model, EMFAC2007, to quantify running exhaust and running loss emissions using user-input traffic data, including peak-hour and off-peak-hour vehicle miles traveled (VMT) data allocated into 5-mph speed bins. Running exhaust emissions are emitted from the vehicle tailpipe while the vehicle is traveling, while running loss emissions are evaporative TOG emissions that occur when hot fuel vapors escape from the fuel system or overwhelm the carbon canister while the vehicle is operating.

Roadway and Traffic Conditions. Modeled traffic volumes and operating conditions were obtained from the traffic data prepared by the project traffic engineers. The data includes volumes within the Traffic Analysis Study Area (TASA), as defined in Chapter 16. Emissions of ozone precursors (ROG and NO_X), CO, PM10, PM2.5, and CO_2 were modeled for existing year (2008), open-to-traffic-year (2025) with and without design options, and design year (2035) with and without design options. Table B-1 summaries the traffic data used in this analysis.

Vehicle Emission Rates. Vehicle emission rates were determined using Caltrans' CT-EMFAC model. VMT distribution by speed bin is presented in Table B-1. The CT-EMFAC model assumed the Sacramento County[2] regional traffic data, operating over an annual season.

B.2 Carbon Monoxide Modeling

Roadway and Traffic Conditions. CO hotspots were evaluated at roadway intersections within the project area for design-year (2035) with and without design options. Peak-hour turning movements at intersections along the Connector corridor and on roadways within the TSAS were obtained from

[1] Please refer to Chapter 4 for a discussion on construction related modeling assumptions.

[2] Because the proposed alignment only stretches three miles into El Dorado County, and the traffic conditions do not change dramatically at the border between Sacramento and El Dorado counties, conditions within Sacramento County were assumed to be representative of the three miles in El Dorado County.

the traffic data prepared by the project traffic engineers (Long pers. comm.). Ambient CO concentrations near the roadway under future project conditions were modeled using CALINE4 (Benson 1989). Note that an analysis of existing (2008) and interim-year (2025) conditions was not completed as peak-hour turning movements at study intersections were not available.

CALINE4 is a Gaussian dispersion model specifically designed to evaluate air quality impacts of roadway projects. Each roadway link analyzed in the model is treated as a sequence of short segments. Each segment of a roadway link is treated as a separate emission source producing a plume of pollutants which disperses downwind. Pollutant concentrations at any specific location are calculated using the total contribution from overlapping pollution plumes originating from the sequence of roadway segments.

CO modeling was conducted at four intersections on the Connector corridor. In addition, modeling was conducted at two intersections on *non-Connector* roadways within the TSAS. These intersections were chosen as they are anticipated to have the greatest traffic volumes and worst LOS/delay. Only the p.m. peak-hour traffic was modeled as the traffic data indicated that LOS and delays would be worse in the p.m. peak-hour than in the a.m. peak hour. The six intersections modeled are:

On Connector Corridor

- White Rock Road and Latrobe Road
- White Rock Road and Off-Vehicle Road
- Teicher Road and Grant Line Road
- SR 99 Northbound Ramps and Grant Line Road

Non-Connector Intersections

- East Bidwell Road and Iron Point Road
- Scott Road and Easton Valley Parkway

Vehicle Emission Rates. Vehicle emission rates were determined using latest version of the ARB's EMFAC2007 emission rate program. Free-flow traffic speeds were adjusted to a speed of 1.0 mph to represent a worst-case scenario. EMFAC2007 modeling procedures followed the guidelines recommended by Caltrans (California Department of Transportation 2003). The program assumed Sacramento County regional traffic data operating during the winter months. A mean winter temperature of 41° F and humidity of 30% were assumed.

Receptor Locations. CO concentrations were estimated at four receptor locations located at each of the six intersections for a total of 24 receptors. The receptors were placed 100 feet from the center of each intersection diagonal, and located 71 feet from the roadway centerline at the boundary of the mixing zone (142 feet from each other) to represent a worst-case scenario. Receptors were chosen based on the CO protocol developed for Caltrans by the Institute of Transportation Studies at the University of California, Davis (Garza et al. 1997). Receptor heights were set at 5.9 feet.

Meteorological Conditions. Meteorological inputs to the CALINE4 model were determined using methodology recommended in Air Quality Technical Analysis Notes (California Department of Transportation 1988). The meteorological conditions used in the modeling represent a calm winter period. The worst-case wind angles were modeled to determine a worst-case concentration for each receptor. The meteorological inputs include: wind speed of 0.5 meters per second, ground-level

Peak Hour

Speed Bin Value	Existing	%	Cumulative 2025 Alternatives										Cumulative 2035 Alternatives									
			No Build	%	LAR	%	Causeway 1	%	Causeway 2	%	Sheldon No-Build	%	No Build	%	LAR	%	Causeway 1	%	Causeway 2	%	Sheldon No-Build	%
1–5	17,694	0.4	16,314	0.3	16,101	0.3	16,383	0.3	18,901	0.3	18,281	0.3	16,432	0.2	18,846	0.3	19,299	0.3	19,572	0.3	18,855	0.3
6–10	40,502	1.0	42,637	0.7	43,831	0.7	43,368	0.7	44,037	0.7	42,186	0.7	45,887	0.6	42,895	0.6	47,084	0.6	45,477	0.6	42,158	0.6
11–15	74,535	1.8	74,601	1.2	70,878	1.1	62,091	1.0	63,570	1	66,453	1.0	84,993	1.2	81,500	1.1	75,942	1.0	84,454	1.1	77,176	1.1
16–20	491,470	11.8	687,760	11.0	681,311	10.8	691,214	10.9	688,178	10.8	676,926	10.7	788,359	10.9	777,284	10.6	780,894	10.6	774,675	10.5	785,841	10.7
21–25	98,831	2.4	154,778	2.5	153,781	2.4	155,545	2.4	155,967	2.5	166,291	2.6	216,828	3.0	229,599	3.1	226,316	3.1	226,927	3.1	232,511	3.2
26–30	241,755	5.8	386,199	6.2	357,795	5.6	367,914	5.8	353,145	5.6	380,303	6.0	615,360	8.5	559,145	7.6	559,418	7.6	553,712	7.5	562,164	7.7
31–35	568,532	13.7	1,071,539	17.2	1,062,760	16.8	1,042,258	16.4	1,061,372	16.7	1,051,523	16.6	1,427,196	19.7	1,446,241	19.7	1,430,099	19.4	1,419,946	19.3	1,441,950	19.7
36–40	716,575	17.2	1,434,194	23.0	1,398,866	22.1	1,398,411	22.0	1,397,430	22	1,396,058	22.0	1,622,840	22.4	1,583,092	21.6	1,612,576	21.9	1,608,397	21.8	1,591,216	21.7
41–45	434,578	10.4	589,342	9.5	586,195	9.3	563,077	8.8	560,929	8.8	581,012	9.2	647,338	8.9	576,516	7.9	525,177	7.1	551,900	7.5	553,178	7.5
46–50	354,988	8.5	606,156	9.7	566,508	8.9	560,457	8.8	564,482	8.9	559,975	8.8	709,136	9.8	702,329	9.6	720,578	9.8	725,724	9.9	716,755	9.8
51–55	508,716	12.2	573,237	9.2	672,538	10.6	673,402	10.6	674,854	10.6	662,976	10.5	480,348	6.6	651,803	8.9	645,605	8.8	635,105	8.6	643,027	8.8
56–60	380,884	9.1	358,182	5.7	484,708	7.6	547,600	8.6	533,892	8.4	493,239	7.8	347,852	4.8	427,829	5.8	477,357	6.5	474,535	6.4	428,094	5.8
61–65	151,736	3.6	240,778	3.9	240,879	3.8	241,164	3.8	241,760	3.8	240,561	3.8	234,833	3.2	241,317	3.3	246,496	3.3	241,244	3.3	241,665	3.3
66–70	83,167	2.0	371	0.0	648	0.0	644	0.0	642	0	647	0.0	1,075	0.0	1,056	0.0	1,047	0.0	1,050	0	1,058	0.0
Total	4,163,963	100	6,236,088	100	6,336,799	100	6,363,528	100	6,359,159	100	6,336,431	100	7,238,477	100	7,339,452	100	7,367,888	100	7,362,718	100	7,335,648	100

Off-Peak Hour

Speed Bin Value	Existing	%	Cumulative 2025 Alternatives										Cumulative 2035 Alternatives									
			No Build	%	LAR	%	Causeway 1	%	Causeway 2	%	Sheldon No-Build	%	No Build	%	LAR	%	Causeway 1	%	Causeway 2	%	Sheldon No-Build	%
1–5	0	0.0	-	0.0	-	0.0	-	0.0	-	0	-	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0
6–10	2,385	0.1	7,779	0.1	7,783	0.1	7,780	0.1	7,789	0.1	7,775	0.1	5,040	0.1	8,527	0.1	8,515	0.1	8,518	0.1	8,531	0.1
11–15	19,140	0.4	11,771	0.2	13,501	0.2	13,494	0.2	13,489	0.2	13,469	0.2	17,005	0.2	11,300	0.1	11,308	0.1	11,325	0.1	12,063	0.1
16–20	426,194	9.0	686,397	9.6	684,999	9.5	684,146	9.4	682,013	9.4	681,552	9.4	815,553	9.8	818,233	9.7	817,205	9.7	817,952	9.7	816,857	9.7
21–25	35,940	0.8	32,934	0.5	32,978	0.5	32,465	0.4	35,346	0.5	35,696	0.5	39,467	0.5	41,420	0.5	40,833	0.5	40,842	0.5	41,153	0.5
26–30	103,083	2.2	172,993	2.4	169,762	2.3	169,539	2.3	169,647	2.3	169,752	2.3	237,130	2.9	235,473	2.8	235,422	2.8	234,963	2.8	237,170	2.8
31–35	326,181	6.9	712,879	10.0	689,317	9.5	701,440	9.7	701,146	9.7	713,902	9.9	811,918	9.8	781,088	9.3	797,016	9.5	797,036	9.5	808,594	9.6
36–40	873,456	18.5	1,903,643	26.7	1,931,294	26.7	1,909,331	26.3	1,909,704	26.3	1,927,191	26.6	2,486,966	30.0	2,486,830	29.6	2,458,155	29.2	2,460,313	29.2	2,479,351	29.5
41–45	524,382	11.1	379,058	5.3	344,634	4.8	335,156	4.6	335,069	4.6	334,124	4.6	350,541	4.2	301,533	3.6	294,769	3.5	294,526	3.5	288,863	3.4
46–50	7,984	0.2	226,473	3.2	155,257	2.1	136,171	1.9	148,513	2	139,575	1.9	294,796	3.6	199,155	2.4	173,736	2.1	177,661	2.1	195,603	2.3
51–55	255,817	5.4	330,665	4.6	286,791	4.0	299,273	4.1	327,210	4.5	312,203	4.3	719,163	8.7	728,009	8.7	663,160	7.9	760,133	9	725,127	8.6
56–60	1,678,026	35.5	2,150,068	30.1	2,427,875	33.5	2,453,446	33.8	2,418,278	33.3	2,397,749	33.1	2,065,032	24.9	2,354,865	28.0	2,474,268	29.4	2,371,767	28.1	2,339,031	27.8
61–65	234,986	5.0	211,968	3.0	188,347	2.6	209,498	2.9	203,143	2.8	194,754	2.7	173,397	2.1	145,152	1.7	137,839	1.6	136,372	1.6	173,988	2.1
66–70	232,807	4.9	314,871	4.4	314,156	4.3	313,439	4.3	313,491	4.3	314,511	4.3	278,548	3.4	297,681	3.5	316,429	3.8	316,502	3.8	278,471	3.3
Total	4,720,381	100	7,141,499	100	7,246,694	100	7,265,178	100	7,264,838	100	7,242,253	100	8,294,556	100	8,409,266	100	8,428,655	100	8,427,910	100	8,404,802	100

Source: Long pers. comm.

temperature inversion (atmospheric stability class G), wind direction standard deviation equal to 5 degrees, ambient temperature of 46° F, and a mixing height of 1,000 meters.

Background Concentrations and 8-Hour Values. To account for sources of CO not included in the modeling, a background concentration of 3.2 parts per million was added to the modeled cumulative 1-hour values, while a background concentration of 2.7 parts per million was added to the modeled cumulative 8-hour values. Background concentration data for 1- and 8-hour CO values were obtained from the EPA's Air Data webpage (U.S. Environmental Protection Agency 2010a). Maximum monitored 1- and 8-hour CO values from the nearest monitoring station (Sacramento Del Paso Manor) for the years 2007–2009 were averaged to obtain a background concentration. The 8-hour modeled values were calculated from the 1-hour values using a persistence factor of 0.6. Background concentrations for design-year (2035) conditions were assumed to be the same as those for the current year. Actual 1- and 8-hour background concentrations in future years would likely be lower than those used in the CO modeling analysis because the trend in CO emissions and concentrations is decreasing due to continuing improvements in engine technology and the retirement of older, higher-emitting vehicles.

B.3 Health Risk Assessment Modeling

The Health Risk Assessment (HRA) for Alternative 2/3 was conducted for the Connector corridor, as well as for adjacent freeway (US 50, SR 99, and I-5) segments. In accordance with the SMAQMD's Protocol, the following three steps were followed in conducting the assessment:

1. Identify roadways with average daily traffic (ADT) volumes in excess of the SMAQMD's screening criteria of 50,000.[3] Segments with less than 50,000 ADT were assumed to present minimal health risks and were therefore excluded from further analysis, per SMAQMD guidance. For segments with greater than 50,000 ADT, Step 2 was complete.
2. Determine nearest sensitive receptor's increased cancer risk using peak hour traffic volumes. Receptors with a predicted risk lower than the SMAQMD's screening criteria of 281 cases per million were excluded from further analysis, per SMAQMD guidance. For receptors with a predicted risk greater than 281 cases per million, Step 3 was completed.
3. Complete a site specific HRA.

B.3.1 Screening Criteria

B.3.1.1 Connector Segments

Peak hour traffic volumes along Connector segments with ADT in excess of 50,000 were obtained from the traffic engineers (Long pers. comm.). According to this data, the highest traffic volumes are no greater than 6,500 vehicles per hour. Rather, traffic on the majority of segments falls between 2,000 and 4,000 vehicles per hour. Based on the SMAQMD screening tables, these peak hour traffic volumes are not representative of conditions that either exceed 281 cases per million or warrant a

[3] The screening criterion of 50,000 is recommended by SMAQMD for *rural* roadways; 100,000 ADT is recommended for *urban* roadways. The rural criterion was used to screen all roadways within the TSAS, including those in urban areas, to ensure a conservative analysis.

site specific HRA (Sacramento Metropolitan Air Quality Management District 2010). Consequently, a site-specific HRA was not conducted for the connector segments. No further analysis was completed.

B.3.1.2 Freeway Segments

The study area for freeway segments includes the following.

- US 50 from Watt Avenue to Bass Lake Road.
- I-5 from Twin Cities Road to Consumes River Boulevard.
- SR 99 from Twin Cities Road to Calvine Road.

Existing year (2008) peak hour ADT for these segments was obtained from the 2008 edition of the *Caltrans' Annual Average Daily Traffic on the California State Highway System* (California Department of Transportation 2008). Based on these values and corresponding receptor locations, seven roadway segments (six roadway segments along US 50 and one roadway segment along SR 99) exceed the Protocol's cancer screening criteria of 281 cases per million (see Table B-2). Consequently, a site-specific HRA was conducted for the segments listed in Table B-2.

Table B-2 HRA Study Segments.

From	To
US 50 Segments	
Watt Ave	Bradshaw Rd
Bradshaw Rd	Mather Field Rd
Mather Field Rd	Zinfandel Dr
Zinfandel Dr	Sunrise Blvd
Sunrise Blvd	Rancho Cordova Pkwy
Rancho Cordova Pkwy	Hazel Ave
SR 99 Segments	
Sheldon Rd	Calvine Rd

B.3.2 Traffic Data for the Site-Specific HRA

Design year (2035) total ADT for the seven study segments indicated in Table B-2 was obtained from the traffic engineers (Long pers. comm.). Since only total ADT was available, peak hour volumes were calculated based on the ratio of peak hour volumes to total ADT under existing conditions (2008) using Caltrans data (California Department of Transportation 2008). According to Caltrans, peak hour volumes in 2008 represented approximately 9-11% of total ADT along the US 50 segments, and 7% of total ADT along the SR 99 segment. Total ADT for the design year on US 50 and SR 99 was multiplied by these factors. This approach is based on the assumption that these values would remain constant in the future and that the project would not change the ratio of peak hour volumes to ADT.

Table B-3presents the total ADT and peak hour traffic volumes used in this assessment. To represent a worst-case scenario, the maximum traffic volume calculated along US 50 was applied to the entire US 50 segment from Watt Avenue to Hazel Avenue.

Table B-3 Peak Hour Volumes on US 50 and SR 99.

Alternative 2/3 Design Option	Maximum ADT (2035)	Maximum Peak Hour Volumes (2035)[a]
US 50 (Watt Avenue to Hazel Avenue)		
No Build	230,000	21,571
LAR	229,000	21,477
Causeway 1 and 2[b]	228,000	21,383
Sheldon No Build	229,000	21,477
SR 99 (Sheldon Road to Calvine Road)		
No Build	162,000	11,465
LAR, Causeway 1 and 2, Sheldon No Build[b]	161,000	11,394

[a] Calculated by multiplying projected 2035 ADT by the ratio of peak hour volumes to Total ADT for 2008 .

[b] Design options do not differ in terms of traffic volumes.

Source: Long pers. comm.; California Department of Transportation 2008

B.3.3 Modeling Procedures

B.3.3.1 Emission Factors

Hourly VMT and PM10 emissions for 2035 were modeled using the Burden[4] mode of the EMFAC2007 (Version 2.3) emissions model and guidance from the Protocol (Sacramento Metropolitan Air Quality Management District 2010). The VMT outputs for each year were normalized using the highest hourly VMT count. Hourly traffic volumes on US 50 and SR 99 were obtained by multiplying the normalized values by the peak hour volumes presented in Table B-3. Hourly PM10 emissions were also calculated from the EMFAC modeled outputs. Table B-4 summarizes the hourly traffic volumes and PM10 emissions factors used in this analysis.

[4] The Burden mode is used for calculating regional (area-specific) emission inventories. In this mode, the model reports total emissions as tons per weekday for each pollutant, by vehicle class and the total vehicle fleet. The Burden mode uses emission factors that have been corrected for ambient conditions and speeds combined with vehicle activity to calculate emissions in tons per day. Vehicle activity includes the number of vehicles, how many miles are driven per day and the number of daily trips. In the Burden mode, the user may select either an hourly or daily total output. (California Department of Transportation n.d).

Table B-4 Hourly Traffic Volumes and PM10 Emission Factors.

	US 50 (vehicles per hour)				SR 99 (vehicles per hour)		
Hour	No Build	LAR	Causeway 1/2[a]	Sheldon No-Build	No Build	LAR, Causeway 1 and 2, Sheldon No-Build[a]	PM 10 (grams/ VMT)
hr 00	3,432	3,364	3,347	3,364	1,690	1,679	0.0181
hr 01	1,356	1,329	1,323	1,329	668	664	0.0458
hr 02	1,548	1,517	1,510	1,517	762	758	0.0401
hr 03	856	839	835	839	422	419	0.0726
hr 04	1,527	1,497	1,490	1,497	752	748	0.0407
hr 05	2,767	2,713	2,699	2,713	1,363	1,354	0.0225
hr 06	10,829	10,616	10,562	10,616	5,333	5,300	0.0230
hr 07	21,884	21,453	21,345	21,453	10,777	10,710	0.0199
hr 08	20,610	20,204	20,102	20,204	10,149	10,087	0.0211
hr 09	12,966	12,710	12,647	12,710	6,385	6,346	0.0240
hr 10	13,630	13,362	13,295	13,362	6,712	6,671	0.0228
hr 11	17,062	16,726	16,642	16,726	8,402	8,350	0.0219
hr 12	17,644	17,296	17,209	17,296	8,689	8,635	0.0211
hr 13	17,404	17,061	16,976	17,061	8,571	8,518	0.0214
hr 14	20,000	19,606	19,508	19,606	9,849	9,788	0.0186
hr 15	20,363	19,962	19,862	19,962	10,028	9,966	0.0214
hr 16	21,445	21,023	20,917	21,023	10,561	10,495	0.0232
hr 17	23,281	22,822	22,708	22,822	11,465	11,394	0.0214
hr 18	16,117	15,799	15,720	15,799	7,937	7,888	0.0193
hr 19	12,055	11,817	11,758	11,817	5,936	5,900	0.0155
hr 20	9,260	9,078	9,032	9,078	4,560	4,532	0.0201
hr 21	9,445	9,259	9,213	9,259	4,651	4,623	0.0197
hr 22	7,055	6,916	6,881	6,916	3,474	3,453	0.0176
hr 23	5,315	5,210	5,184	5,210	2,617	2,601	0.0234

[a] Design options do not differ in terms of traffic volumes.

It should be noted that the SMAQMD's HRA modeling protocol does not allow for adjustments in the per-vehicle emission rate over the analysis exposure duration, despite the fact that emission controls are required to be improved, by federal and California regulatory requirements. Not only will new vehicles be required to meet these standards, some existing vehicles (such as heavy duty trucks) will be required to be retrofitted. These emission controls predominantly effect diesel-powered vehicles, which produce the majority of diesel particulate emissions that can contribute to adverse health effects. What this means is that, over time, PM10 emissions are not only expected, but are required, to be substantially reduced from the overall vehicle fleet. Because the modeling protocol does not allow for this adjustment—it assumes vehicle emission rates will remain static at current levels for the 2008 and 2035 analysis scenarios over the entire exposure duration—this can result in a highly conservative risk assessment that can over-predict expected cancer risks.

While the assessment of health risks includes an unrealistic assumption that emission rates will remain constant and do not reflect the anticipated decrease in emission rates over time, this is somewhat offset by assumption that traffic volumes will remain static over the assessment's exposure duration for each scenario evaluated. For example, the analysis scenario evaluates cancer risks associated exposure to 2035 traffic volumes over a 70-year exposure duration. This represents an unrealistic assumption because traffic volumes tend to increase with time, consistent with increases in regional population over time.

B.3.3.2 Roadway and Receptor Locations

Cartesian coordinates marking the beginning and end of the US 50 and SR 99 study segments were converted to x-y coordinates. Segment widths were based on the number of travel lanes anticipated under deign year (2035) conditions. According to DKS, US 50 between Watt and Hazel Avenue is proposed to have 10 lanes, while SR 99 between Sheldon and Calvine Road is proposed to have six lanes (Long pers. comm.). In accordance with the Protocol, each lane was assumed to be 12 feet in width with an additional 10 feet on each side of the roadway to account for the wake of moving vehicles.

Sixteen receptors were placed perpendicular to midway points on both US 50 and SR 99 for a total of 32 receptors. These receptors extended northward and southward on US 50, and eastward and westward on SR 99. Based on SMAQMD's Protocol, the receptors were placed at 10, 25, 50, 100, 200, 300, 400, and 500 foot increments from the roadway's edge. To account for breathing height, all receptors were placed at a height of six feet, as per the SMAQMD Protocol.

B.3.3.3 CAL3QHCR Parameters

PM10 concentrations at each of the defined receptor locations were modeled using the CAL3QHCR model and methodology recommended by the SMAQMD Protocol. Table B-5 summarizes the main assumptions used in the modeling methodology. Emission factors and hourly traffic volumes were calculated using the EMFAC2007 model outputs and are presented in Table B-3 and Table B-4.

Table B-5 CAL3QHCR Assumptions.

Parameter	Assumption
Calculation Averaging Time	60
Surface Roughness Coefficient	108
Settling Velocity (cm/s)	0
Deposition Velocity (cm/s)	0
Hourly Ambient Background Concentration (μg/m^3)	0
Roadway Height (feet)	At grade, 0

B.3.3.4 Calculation of Cancer Risk

The calculation of health risks was done following the ARB's Recommended Interim Risk Management Policy for Inhalation Based Cancer Risk. The cancer risk occurs exclusively through the inhalation pathway; therefore the inhalation dose must first be calculated using the following equation:

$$Dose = \frac{(Cair)(DBR)(A)(EF)(ED)(1X\ 10^{-6})}{AT}$$

where,

Dose = Dose through inhalation (mg/kg/d)

$1X\ 10^{-6}$ = Micrograms to milligrams conversion

Cair = Concentration in air (µg/m^3), annual average from CAL3QHCR

DBR = Daily breathing rate (L/kg body weight-day), 302

A = Inhalation absorption factor, 1

EF = Exposure frequency, 350 days/year

ED = Exposure duration, 70 years

AT = Averaging time, 25550 days

Once the dose is obtained, the cancer risk can be estimated according to the following equation:

$$Cancer\ Risk = (Dose)(Cancer\ Potency)(1X\ 10^{6})$$

where,

Cancer Risk = Chances per million people

Dose = Dose through inhalation (mg/kg/d)

Cancer Potency = 1.1 /kg-day/mg

$1\ X\ 10^{6}$ = Risk per million people

The cancer potency factor incorporates worst case, health-protective assumptions. It was established using data from animal and epidemiological exposure studies and represents the increased chance or probability of developing cancer assuming continuous lifetime exposure.

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