Appendix 4.2-D Diesel Exposure

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality

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October 13, 2008

Marsha Sue Lustig
Assistant to the City Manager
City of Cotati
201 West Sierra Avenue
Cotati, CA 94931

VIA email: MSLUSTIG@ci.cotati.ca.us

SUBJECT: Cotati Dowtown Plan Diesel Particulate Matter Exposures from US 101

Dear Marsha Sue:

At your request, we have evaluated future exposures of diesel particulate matter (DPM) emitted from U. S. Highway 101 in Cotati. We understand that the proposed Downtown Plan could place sensitive receptors, such as residences, near the highway. A health risk assessment was conducted to evaluate the significance of these exposures.

There are no major stationary sources of air toxic contaminants near or in the Downtown Cotati Plan Area. However, portions of the plan area are located adjacent to U. S. Highway 101 (Highway 101), where vehicles passing by generate emissions of diesel particulate matter. Much of these emissions are generated from truck trips. The BAAQMD and CARB recommend that Cities include buffers between sensitive receptors and sources of toxic air contaminant (TAC) emissions and odors. In April 2005, CARB released the final version of the Air Quality and Land Use Handbook, which is intended to encourage local land use agencies to consider the risks from air pollution prior to making decisions that approve the siting of new sensitive receptors near sources of air pollution. The CARB recommends setbacks of 500 feet between freeways and new sensitive receptors, such as residences. However, these recommendations are fairly generic and do not take into account the difference in traffic conditions on each highway throughout the State. Site-specific meteorological conditions are also not considered. As a result, the CARB recommendation is not reflective of the exposures presented by freeways with lower traffic volumes. In addition, CARB acknowledges that land use agencies have to balance other siting considerations such as housing and transportation needs, economic development priorities and other quality of life issues.

Siting of new sensitive land uses within the CARB recommended buffer distance may be possible, but only after project- or site-specific studies are conducted to identify the actual health risks. Furthermore, the BAAQMD Guidelines consider exposure of sensitive receptors to air pollutant levels that result in an unacceptable cancer risk or hazard to be significant. Diesel particulate matter is identified as a toxic air contaminant (TAC) by CARB due to the potential to cause cancer. Hazards associated with diesel exhaust have not been identified. For cancer risk, which is the main concern with diesel particulate matter, the BAAQMD considers a risk of contracting cancer that is 10 in one million chances or greater to be significant. The CARB guidelines for freeways are mostly based on this level of health risk that the BAAQMD uses. Therefore, an exposure that is within the 500-foot buffer that would not be expected to experience a significant health risk (i.e., cancer risk) should be considered acceptable from an air quality standpoint.

Background Risk

Since identifying diesel particulate matter as a toxic air contaminant, CARB has conducted studies to identify existing health effects from exposure to DPM. The CARB has identified the average year 2000 statewide potential lifetime cancer risks at 540 excess cases per million people. The potential risk near high volume freeways was found to be much higher. The risk is predicted to decrease in the future due to efforts to reduce diesel particulate matter emissions from a variety of sources. The 2000 CARB report predicts an average statewide risk at 360 excess cancer cases per million people in 2020. Modeling information compiled by CARB indicates that the cancer risk due to DPM in Cotati would be around 100 excess cases per million people in 2010.

Analysis of Site-Specific DPM Cancer Risk

Future health risk from exposure to diesel particulate matter emitted from Highway 101 traffic was predicted. The health risk involved prediction of vehicle emission rates, prediction of traffic levels and dispersion modeling of emissions.

Emissions

Future DPM emissions for traffic on Highway 101 were developed using the latest version of the CARB EMFAC2007 emission factor model with defaults for Sonoma County. Vehicle emission rates of exhaust PM_{10} were obtained from the model. Lower future vehicle emission rates that have been established by regulations through 2006 were taken into account in the analysis. Note that DPM emissions are anticipated to decrease in the future. CARB has been developing new regulations and emission standards since identifying DPM as a carcinogenic. Some of these requirements take time to provide substantial emission reductions. For example, new trucks would have considerably lower emission rates than older trucks, but older trucks will only slowly leave the vehicle fleet. CARB is considering regulations that would require retrofitting or replacement of older trucks in the near future that would expedite the expected reduction in DPM emissions. Since this analysis assessed the risk of proposed residences to future exposures, the lower future emissions were taken into account. The EMFAC2007 results were then adjusted to the traffic mix on I-80 reported by Caltrans. Emission factors were developed for 2015 (the earliest sites near the freeway could be developed and occupied), 2025 and 2035, using the calculated mix of diesel-fueled vehicles.

CARB's diesel reduction plan includes proposed regulatory actions developed in 2000 that are intended to substantially decrease emissions of DPM. CARB has implemented many of the control measures outlined in the plan and most of those actions are reflected in the EMFAC2007 model runs. Future regulatory actions and additional measures not yet adopted that would lower emissions rates were not included. Such measures include a proposed regulation by CARB to reduce DPM emissions from in-use on-road diesel-fueled vehicles, which would require truck fleet owners to either retrofit or phase out older engines over time.

Traffic Levels

Caltrans reports daily annual average truck traffic for California highways. The traffic information for segments of Highway 101 on both sides of the Gravenstein Highway was used for this analysis. Caltrans reports total average daily vehicle volumes as well as truck data. The truck types are broken down based on the number of axles. The EMFAC2007 model provides default values for the engine technology type of each truck category engine (i.e., diesel or gasoline powered). Traffic levels were assumed to increase by about 1% per year.

Dispersion Model

The dispersion model predicts hourly DPM concentrations using traffic data (vehicles per hour), emissions rates, combined with nearby historical hourly meteorological data. Since nearby historical

meteorological data were not available, a set of data were used that tend to result in poor dispersion conditions. These include a low wind speed of 1 meter per second, a wind direction that results in the highest concentration, and very stable atmospheric conditions. These are considered screening meteorological conditions that tend to overstate air pollutant concentrations. Inputs along with computed results at receptors are contained in the Attachment. Resulting DPM concentrations are reported as micrograms per cubic meter ($\mu g/m^3$).

Predicted Cancer Risk

The California Office Of Environmental Health Hazard Assessment (OEHHA) recommends the 70-year lifetime exposure period for determining residential cancer risks. This recommendation is accepted by BAAQMD and required for use in risk assessments, including those conducted for CEQA only purposes. According to OEHHA, exposure durations of 9-years and 30-years may also be evaluated as supplemental information to show the range of cancer risk based on residency periods. The U.S. EPA considers 9 years to be the estimate of average residence time, 30-years to be the high-end of residence time, and 70-years to be representative of lifetime exposure.

The 70-year exposure period ensures that a person residing in the vicinity of a freeway for a lifetime would be included in the evaluation. The lifetime (or 70-year exposure) has been the historical benchmark for comparing facility impacts on sensitive receptors. OEHHA recognizes that although it is not likely that most people will reside at a single residence for 70 years, it is common that people will spend their entire lives in a major urban area. While residing in urban areas it is quite possible to be exposed to the emissions of other sources at the next residence. In addition, people may increase their exposure to DPM or other TACs when they are not at their residences (e.g., traveling on highways).

The maximum individual cancer risks for positions relative to the edge of U.S. 101 were computed from modeled concentrations using the methods recommended by (OEHHA) for continuous exposure over a 70-year lifetime beginning in 2015. Computed 70-year cancer risks along Highway 101 both north and south of State Route 116 are reported in Table 1

Table 1. 70-Year Weighted Cancer Risk (chances per million)

	Cancer Risk (per million) at Receptor Distance Relative to U.S. 101**								
Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
Highway 101 North of State Route 116									
Year 2015	29.1	19.1	13.8	10.2	7.6	5.9	4.6	3.6	2.0
Year 2025	17.1	11.2	8.2	6.1	4.6	3.6	2.8	2.0	1.3
Year 2035	15.3	10.2	7.1	5.4	4.1	3.1	2.5	1.8	1.0
70-Year Weighted Risk*	17.5	11.6	8.2	6.2	4.7	3.5	2.9	2.1	1.2
Highway 101 South of State Route 116									
Year 2015	32.6	21.4	15.3	11.5	8.7	6.6	5.1	4.1	2.3
Year 2025	18.9	12.5	8.9	6.6	5.1	3.8	3.1	2.3	1.3
Year 2035	16.6	11.0	7.9	5.9	4.3	3.3	2.5	2.0	1.3
70-Year Weighted Risk*	19.2	12.7	9.1	6.8	5.1	3.9	3.0	2.4	1.4

* Assumes exposure period 2015 through 2085, where traffic and emissions remain constant after 2035.

As shown in Table 1, cancer risk is expected to decrease in future years as emissions of diesel particulate matter from trucks and other vehicles decrease. The cancer risk in 2035 is expected to be half of that predicted in 2015. A person residing 125 feet from the edge of the Highway 101 north of State Route 116 would have a lifetime cancer risk of 10 in one million. A similar risk would occur for someone residing 135 feet from Highway 101 south of State Route 116. The difference in risk is attributable to the slightly higher volume of trucks that Caltrans reports south of State Route 116. People residing further away would have a lower risk. Since the BAAQMD considers lifetime cancer risk greater than 10 in one million as significant, the placement of new residences within 125 feet of the edge of Highway 101 should be avoided. Since this analysis included screening level predictions, it is possible that site-specific studies may result in lower predicted cancer risks.

Proposed Mitigation Measure

Implement the following Downtown Plan Policy: *Sensitive receptors such as residences shall not be placed within 135 feet of the edge of US 101 traffic lanes unless project specific studies show the associated health risk posed by traffic would not conflict with Bay Area Air Quality Management Health Risk policy (i.e., result in lifetime cancer risks that exceed 10 in one million).*

Note – one could refer to this study to allow a buffer of 125 feet for development north of State Route 116.

* * *

This concludes our analysis of the diesel particulate matter exposure from U.S. Highway 101 traffic. Please call us if you have any questions regarding this report.

Sincerely,

James A. Reyff
Illingworth & Rodkin, Inc.

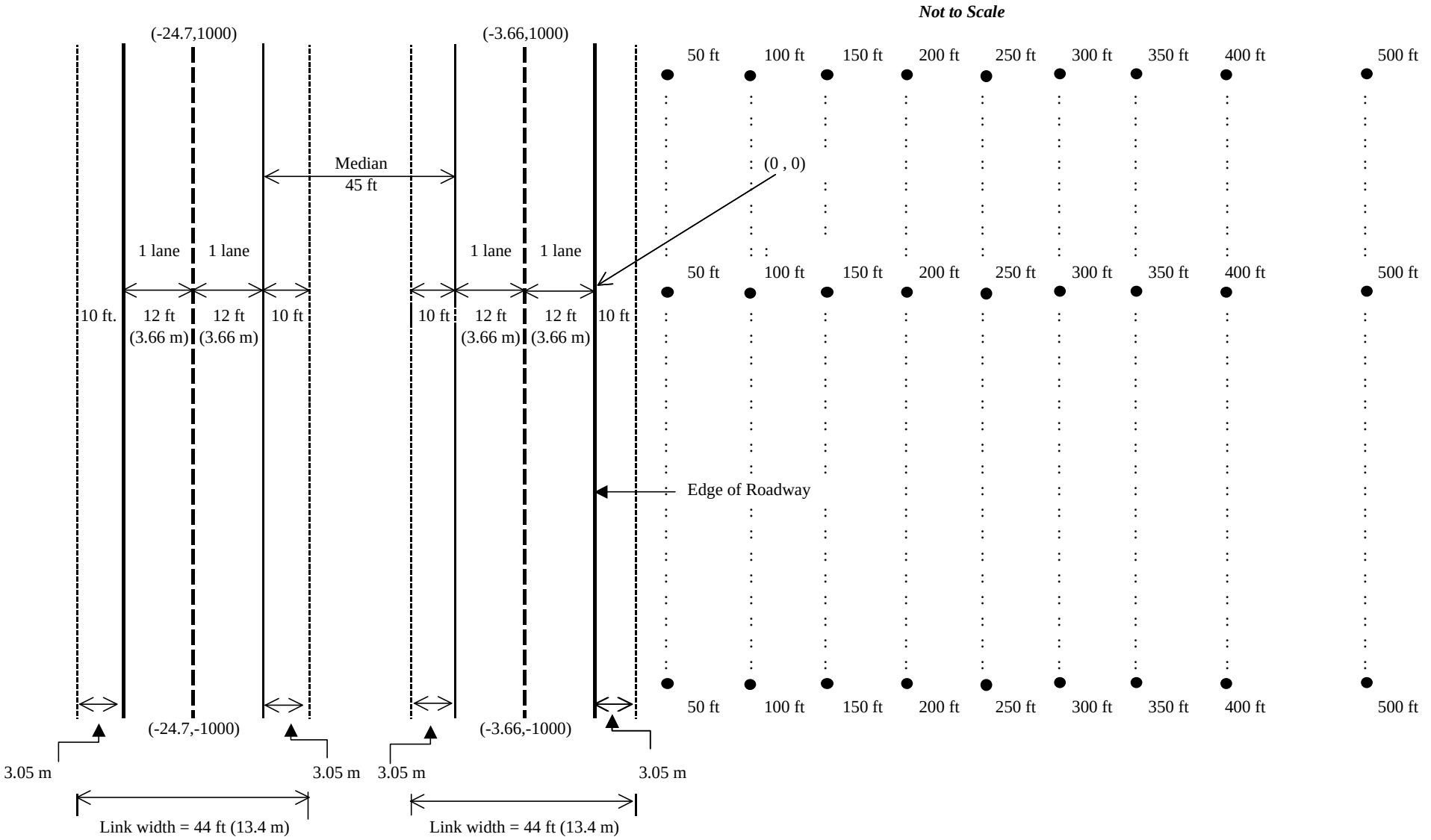
Attachment

Job # 08-176

ATTACHMENT

Highway 101 Modeling Setup - Cotati

Coordinates in parenthesis



Cotati -Highway 101 North of SR 116 DPM Risk Modeling Using Cal3qhc - 70 Year Exposure

Roadway Information

Number of Lanes =	4	(2 northbound, 2 southbound)
Lane Width =	12	feet

CAL3QHC Link/Source Information

Num of Links =	2	
Link Length =	2000	m
Link Width =	44 ft	13.4 m
Release Height =	10 ft	3 m

DPM Emission Factors

Model	EMFAC2007
County	Sonoma (SF)

Receptor Information

Number of Receptors	369
Receptor distances =	at 50 ft, 100 ft, 150 ft, 200 ft, 250 ft, 300 ft, 350 ft, 400 ft & 500 ft perpendicular to the highway, spaced every 50 m parallel to the highway

Meteorological Conditions

Land Use Classification	Suburban
Stability class =	D, E, & F
Wind speed =	1 m/s
Wind direction =	Worst-case wind angle search (0 to 180 degrees in 10 degree increments)
Surface roughness =	100 cm

Cancer Risk Calculation Method

Inhalation Dose = C_{air} x DBR x A x EF x ED x 10^{-6} / AT

Where: C_{air} = concentration in air ($\mu g/m^3$)
DBR = daily breathing rate (L/kg body weight-day)
A = Inhalation absorption factor
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
AT = Averaging time period over which exposure is averaged.
10^{-6} = Conversion factor

Inhalation Dose Factors

Exposure Type	Value[1] DBR (L/kg BW -d	A (-)	Exposure (hr/day)	EF (days/yr)	ED (Years)	AT (days)
Residential (70-Year)	302	1	24	350	70	25,550
Residential (30-Year)	302	1	24	350	30	25,550
Residential (9-year)	302	1	24	350	9	25,550
Residential-Child	581	1	24	350	9	25,550
Off-Site Worker	149	1	8	245	40	25,550
Student	581	1	10	180	9	25,550

[1] Default values recommended by OEHHA

Cancer Risk (per million) = CPF x Inhalation Dose x 1.0E6
= URF x Cair

Where: CPF = Cancer potency factor $(mg/kg\text{-}day)^{-1}$
URF =Unit risk factor (cancer risk per $\mu g/m^3$)

Diesel Particulate Matter Unit Risk Factors

Exposure Type	CPF (mg/kg-day)[1]	URF *(Risk/million/µg/m ^{3})*
Residential (70-Yr Exposure)	1.10E+00	318.5
Residential (30-Yr Exposure)	1.10E+00	136.5
Residential (9-Yr Exposure)	1.10E+00	41.0
Residential Child (9-Yr Exposure)	1.10E+00	78.8
Off-Site Worker	1.10E+00	62.87

Summary of DPM Concentrations and Resulting Risks - 70-Year Exposure

2015 Emissions	1-Hour Maximum Conc (ug/m3) at Receptor s*								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	1.14	0.75	0.54	0.40	0.30	0.23	0.18	0.14	0.08
E at 1 m/s	0.66	0.44	0.33	0.26	0.21	0.17	0.14	0.12	0.08
D at 1 m/s	0.47	0.31	0.23	0.18	0.15	0.12	0.10	0.09	0.06
	Risk (per million) at Receptor Distance (70-Year Exposure)**								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	29.1	19.1	13.8	10.2	7.6	5.9	4.6	3.6	2.0
E at 1 m/s	16.8	11.2	8.4	6.6	5.4	4.3	3.6	3.1	2.0
D at 1 m/s	12.0	7.9	5.9	4.6	3.8	3.1	2.5	2.3	1.5

* Distances are from the edge of the roadway

** Conversion factor for 1-hr to annual average conc. of 0.08

2025 Emissions	1-Hour Maximum Conc (ug/m3) at Receptor s*								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	0.67	0.44	0.32	0.24	0.18	0.14	0.11	0.08	0.05
E at 1 m/s	0.39	0.26	0.20	0.15	0.12	0.10	0.08	0.07	0.05
D at 1 m/s	0.28	0.18	0.14	0.11	0.09	0.07	0.06	0.05	0.04
	Risk (per million) at Receptor Distance (70-Year Exposure)**								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	17.1	11.2	8.2	6.1	4.6	3.6	2.8	2.0	1.3
E at 1 m/s	9.9	6.6	5.1	3.8	3.1	2.5	2.0	1.8	1.3
D at 1 m/s	7.1	4.6	3.6	2.8	2.3	1.8	1.5	1.3	1.0

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2035 Emissions	1-Hour Maximum Conc (ug/m3) at Receptor s*								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	0.60	0.40	0.28	0.21	0.16	0.12	0.10	0.07	0.04
E at 1 m/s	0.35	0.24	0.18	0.14	0.11	0.09	0.07	0.06	0.04
D at 1 m/s	0.25	0.16	0.12	0.10	0.08	0.07	0.06	0.05	0.03
	Risk (per million) at Receptor Distance (70-Year Exposure)**								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	15.3	10.2	7.1	5.4	4.1	3.1	2.5	1.8	1.0
E at 1 m/s	8.9	6.1	4.6	3.6	2.8	2.3	1.8	1.5	1.0
D at 1 m/s	6.4	4.1	3.1	2.5	2.0	1.8	1.5	1.3	0.8

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Cotati -Highway 101 South of SR 116 DPM Risk Modeling Using Cal3qhc - 70 Year Exposure

Roadway Information

Number of Lanes =	4	(2 northbound, 2 southbound)
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Stability class =	D, E, & F
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Inhalation Dose = C_{air} x DBR x A x EF x ED x 10^{-6} / AT

Where: C_{air} = concentration in air ($\mu g/m^3$)
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Residential (30-Year)	302	1	24	350	30	25,550
Residential (9-year)	302	1	24	350	9	25,550
Residential-Child	581	1	24	350	9	25,550
Off-Site Worker	149	1	8	245	40	25,550
Student	581	1	10	180	9	25,550

[1] Default values recommended by OEHHA

Cancer Risk (per million) = CPF x Inhalation Dose x 1.0E6
= URF x Cair

Where: CPF = Cancer potency factor $(mg/kg\text{-}day)^{-1}$
URF =Unit risk factor (cancer risk per $\mu g/m^3$)

Diesel Particulate Matter Unit Risk Factors

Exposure Type	CPF (mg/kg-day)[1]	URF *(Risk/million/µg/m ^{3})*
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Residential (30-Yr Exposure)	1.10E+00	136.5
Residential (9-Yr Exposure)	1.10E+00	41.0
Residential Child (9-Yr Exposure)	1.10E+00	78.8
Off-Site Worker	1.10E+00	62.87

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F at 1 m/s	1.28	0.84	0.60	0.45	0.34	0.26	0.20	0.16	0.09
E at 1 m/s	0.75	0.50	0.37	0.29	0.23	0.19	0.16	0.13	0.09
D at 1 m/s	0.53	0.35	0.25	0.21	0.17	0.14	0.12	0.10	0.07
	Risk (per million) at Receptor Distance (70-Year Exposure)**								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	32.6	21.4	15.3	11.5	8.7	6.6	5.1	4.1	2.3
E at 1 m/s	19.1	12.7	9.4	7.4	5.9	4.8	4.1	3.3	2.3
D at 1 m/s	13.5	8.9	6.4	5.4	4.3	3.6	3.1	2.5	1.8

* Distances are from the edge of the roadway

** Conversion factor for 1-hr to annual average conc. of 0.08

2025 Emissions	1-Hour Maximum Conc (ug/m3) at Receptor s*								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	0.74	0.49	0.35	0.26	0.20	0.15	0.12	0.09	0.05
E at 1 m/s	0.43	0.29	0.21	0.17	0.14	0.11	0.09	0.08	0.05
D at 1 m/s	0.31	0.20	0.15	0.12	0.10	0.08	0.07	0.06	0.04
	Risk (per million) at Receptor Distance (70-Year Exposure)**								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	18.9	12.5	8.9	6.6	5.1	3.8	3.1	2.3	1.3
E at 1 m/s	11.0	7.4	5.4	4.3	3.6	2.8	2.3	2.0	1.3
D at 1 m/s	7.9	5.1	3.8	3.1	2.5	2.0	1.8	1.5	1.0

* Distances are from the edge of the roadway

** Conversion factor for 1-hr to annual average conc. of 0.08

2035 Emissions	1-Hour Maximum Conc (ug/m3) at Receptor s*								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	0.65	0.43	0.31	0.23	0.17	0.13	0.10	0.08	0.05
E at 1 m/s	0.38	0.25	0.19	0.15	0.12	0.10	0.08	0.07	0.05
D at 1 m/s	0.27	0.18	0.13	0.10	0.08	0.07	0.06	0.05	0.04
	Risk (per million) at Receptor Distance (70-Year Exposure)**								
Meteorological Conditions	15.25 m **50 ft**	30.5 m **100 ft**	45.75 m **150 ft**	60.96 m **200 ft**	76.2 m **250 ft**	91.44 m **300 ft**	106.7 **350 ft**	121.9 m **400 ft**	152.4 m **500 ft**
F at 1 m/s	16.6	11.0	7.9	5.9	4.3	3.3	2.5	2.0	1.3
E at 1 m/s	9.7	6.4	4.8	3.8	3.1	2.5	2.0	1.8	1.3
D at 1 m/s	6.9	4.6	3.3	2.5	2.0	1.8	1.5	1.3	1.0

* Distances are from the edge of the roadway