

Air Quality Calculations

1. Equipment List

Equipment Type	Mfr/Model	Quantity	Horsepower
<i>Off Road Construction (onsite)</i>			
Loader	CAT 966G	2	233
Forklift	CAT TH83	2	109
Excavator	CAT 330	2	268
<i>On Road Vehicles (offsite)</i>			
Grove Boom Truck RT 522	RT 522	1	150
Flat Bed Truck	Chevy	1	250
Pick Up Truck	Chevy/Silverado	4	200
Fuel/Service Truck	Kenworth	1	225
Water Truck (3600 gallons)	Kenworth	1	400
<i>Marine Vessels and Equipment (onsite)</i>			
DB 24 (with Amclyde 28 crane)	CAT 3412	1	525
CB 8 (with Bucyrus-Erie 88B crane)	Cummins V1710	1	365
CB Doolittle (with Bucyrus-Erie 65D crane)	Cummins 855	1	280
Workboat	John Deer 400	3	600
Tugboat "Sarah Reed"	Cummins KTA38	2	1700
Dump Scow 5	CAT 3208	2	210
Flat Deck Material Barge	N/A	6	
Vibratory Hammer	APE 200/CAT C16	1	630
Generator 25KW	Rental	4	35

Notes:

Equipment list per The Dutra Group, August 2008

2. Construction Schedule

Project Activity	Schedule			
	hrs/day	days/wk	months	hours
Dredging	24	7	0.2	146
Rock Placement	10	7	1.1	334
Pile Driving	10	7	2.1	637
Vessels Tending (concurrent)	12	7	2.4	874
Totals	10	7	3.4	

Notes:

Construction schedule per The Dutra Group, August 2008

3. Sheet Pile Fuel

Equipment Type	Equip. Qty.	Rating BHP	Load factor	Daily hours	Project hours	Hourly gals	Daily gals	Project gals
Off Road Construction (onsite)								
Loader	2	233	25%	10	334	6	59	1,984
Forklift	2	109	25%	10	334	3	28	928
Excavator	2	268	25%	10	146	7	68	998
On Road Vehicles (offsite)								
Grove Boom Truck RT 522	1	150	25%	5	167	2	10	319
Flat Bed Truck	1	250	25%	5	167	3	16	532
Pick Up Truck	4	200	25%	5	167	10	51	1,703
Fuel/Service Truck	1	225	25%	5	167	3	14	479
Water Truck (3600 gallons)	1	400	25%	5	167	5	26	852
Marine Vessels and Equipment (onsite)								
DB 24 (with Amclyde 28 crane)	1	525	75%	24	146	20	482	2,932
Dump Scow 5	2	210	25%	24	146	5	129	782
CB 8 (with Bucyrus-Erie 88B crane)	1	365	75%	10	334	14	140	4,663
CB Doolittle (with Bucyrus-Erie 65D crane)	1	280	25%	10	637	4	36	2,274
Workboat	3	600	15%	12	874	14	165	12,035
Tugboat "Sarah Reed"	2	1700	15%	12	874	26	312	22,733
Generator 25KW	4	35	50%	10	637	4	36	2,274
Vibratory Hammer	1	630	50%	10	637	16	161	10,233
Site Preparation Maximum Totals (mgal)						0.072	1.156	
Construction Maximum Totals (mgal)						0.110	1.054	
Project Total (mgal)								65.721

Project Activity	Hourly gal/hr	Daily gal/day	Project gallons
Off Road Construction	20	160	3,900
On Road Vehicles	20	120	3,900
Marine Vessels and Equipment	100	1,460	57,900
Maximum Rates	110	1,160	65,700

Notes:

BSFC = (7,000 BTU/BHP-hr) / (137,030 BTU/gal) = 0.051 gal/BHP-hr

AP-42 Table 3.3-1

Equipment Type	Daily hours	Project hours
DB 24 (with Amclyde 28 crane)	24	146
Dump Scow 5	24	146
CB 8 (with Bucyrus-Erie 88B crane)	10	334
CB Doolittle (with Bucyrus-Erie 65D crane)	10	637
Workboat	12	874
Tugboat "Sarah Reed"	12	874
Generator 25KW	10	637
Vibratory Hammer	10	637

4. Sheet Pile Emissions

SIC	1629	Heavy Construction, not elsewhere classified	
PROCESS EQPT DESCRIPTION	Diesel Engine, Nonroad Tiers		
FUEL TYPE/PROCESS INFO	California Ultra Low Sulfur Diesel, 15 ppmw S		
TOTAL PROCESS RATE	65.721	mgal/yr	project
DAILY MAX PROCESS RATE	1.156	mgal/day	site prep
HOURLY MAX PROCESS RATE	0.110	mgal/hr	construction
DAILY MAX SCHEDULE	10	hrs/day	
HEAT RATE	7000	BTU/bhp-hr	

EMITTENT	FACTOR	ANNUAL	ANNUAL	DAILY	HOURLY
	lb/mgal	lbs/yr	tons/yr	lbs/day	lbs/hr
Oxides of Nitrogen (as NO ₂)	276.2	18,152	9.08	319.3	30.38
Hydrocarbons (ROC as CH ₄)	30.2	1,985	0.99	34.9	3.32
Carbon Monoxide (CO)	164.0	10,778	5.39	189.6	18.04
Particulates (as PM ₁₀)	17.3	1,137	0.57	20.0	1.90
Sulfur Dioxide (SO ₂)	0.2	13	0.01	0.2	0.02
Carbon Dioxide (GHG - CO ₂)	22,485	1,477,730	738.87	25,992.5	2,473.34
Nitrous Oxide (GHG - N ₂ O)	0.6	39	0.02	0.7	0.07
Methane (GHG - CH ₄)	1.3	85	0.04	1.5	0.14
Diesel Particulate Matter (DPM)	17.3	1,137	0.57	20.0	1.90
Fugitive Dust (as PM ₁₀)		2,866	1.43	28.1	2.81

Notes:

Composite emission factors per Nonroad Tiered Factors

5. Onsite Fugitive Dust

Sheet Pile	Area	Schedule	Control	Uncontrolled		Controlled	
	acres	days	percent	lbs/day	lbs/yr	lbs/day	lbs/yr
Bacon Island	4.13	102	95%	211	21,496	11	1,075
Holland Tract	4.13	102	95%	211	21,496	11	1,075
Connection Slough	2.75	102	95%	140	14,331	7	717
Totals	11.02			562	57,322	28	2,866

Source:

Fugitive dust (as PM₁₀) 51 lb/acre-day unmitigated, BAAQMD CEQA Guidelines, Section 3.3

BAAQMD Ref: AP-42 Chapter 13.2.3 "Heavy Construction Operations"

Mitigation Ref: AP-42 Chapter 13.2.2 "Unpaved Roads", Figure 13.2.2-2

Notes:

Soil moisture ratio = 5 (for all feasible mitigation measures)

6. Offsite Truck Trips

SIC	1629	Heavy Construction, not elsewhere classified	
PROCESS EQPT DESCRIPTION	Truck Trips - Sheet Pile		
FUEL TYPE/PROCESS INFO	Diesel		
	<u>miles</u>	<u>trips</u>	
TOTAL PROCESS RATE	48960	816	per year RT
DAILY AVG PROCESS RATE	480	8	per day RT
HOURLY MAX PROCESS RATE	120	4	per hour OW

EMITTENT	FACTOR	FACTOR	ANNUAL	ANNUAL	DAILY	HOURLY
	g/mile	g/trip	lbs/yr	tons/yr	lbs/day	lbs/hr
Oxides of Nitrogen (as NO ₂)	4.85		523.5	0.262	5.13	1.28
Hydrocarbons (ROC as CH ₄)	0.081		8.7	0.004	0.09	0.02
Carbon Monoxide (CO)	0.902		97.3	0.049	0.95	0.24
Particulates (as PM ₁₀)	0.145		15.6	0.008	0.15	0.04
Sulfur Dioxide (SO ₂)	0.014		1.5	0.001	0.01	0.00
Carbon Dioxide (GHG - CO ₂)	1,368		147,544	74	1,447	362
Nitrous Oxide (GHG - N ₂ O)	0.0048		0.5	0.000	0.01	0.00
Methane (GHG - CH ₄)	0.0051		0.5	0.000	0.01	0.00
Diesel Particulate Matter (DPM)	0.145		15.6	0.008	0.15	0.04
Fugitive Dust (as PM ₁₀)	10		1,111	1	11	3

Notes:

Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007, EPA 2009

Table A- 99: Emission Factors for CH₄ and N₂O for Highway Vehicles

EMFAC 2007, MD HD Trucks MY 2005

AP-42 Section 13.2.2 Unpaved Roads, Equation 1b, 95% controlled (watering)

20% of travel on dirt roads (6/30 miles)

7. Offsite Worker Commutes

SIC	1629	Heavy Construction, not elsewhere classified	
PROCESS EQPT DESCRIPTION	Worker Commutes - Sheet Pile		
FUEL TYPE/PROCESS INFO	Gasoline		
	<u>miles</u>	<u>trips</u>	
TOTAL PROCESS RATE	244800	4080	per year RT
DAILY AVG PROCESS RATE	2400	40	per day RT
HOURLY MAX PROCESS RATE	600	20	per hour OW

EMITTENT	FACTOR	FACTOR	ANNUAL	ANNUAL	DAILY	HOURLY
	g/mile	g/trip	lbs/yr	tons/yr	lbs/day	lbs/hr
Oxides of Nitrogen (as NO ₂)	0.76	0.89	417.8	0.209	4.10	1.04
Hydrocarbons (ROC as CH ₄)	0.22	0.79	125.7	0.063	1.23	0.33
Carbon Monoxide (CO)	3.66	12.85	2,089.0	1.044	20.48	5.40
Particulates (as PM ₁₀)	0.44		237.3	0.119	2.33	0.58
Sulfur Dioxide (SO ₂)	0.03		16.2	0.008	0.16	0.04
Carbon Dioxide (GHG - CO ₂)	193.06		104,099	52	1,021	255
Nitrous Oxide (GHG - N ₂ O)	0.0051		2.7	0.001	0.03	0.01
Methane (GHG - CH ₄)	0.0168		9.1	0.005	0.09	0.02
Diesel Particulate Matter (DPM)	0.000		0.0	0.000	0.00	0.00
Fugitive Dust (as PM ₁₀)	10		5,557	3	54	14

Notes:

Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007, EPA 2009

Table A- 99: Emission Factors for CH₄ and N₂O for Highway Vehicles

EMFAC 2007, LT PC & LT PU, MY 2005

AP-42 Section 13.2.2 Unpaved Roads, Equation 1b, 95% controlled (watering)

20% of travel on dirt roads (6/30 miles)

8. Onsite Emissions Summary

Project Emissions	Construction		
	tons	lb/day	lb/hr
Oxides of Nitrogen (as NO ₂)	9.08	319.29	30.38
Hydrocarbons (ROC as CH ₄)	0.99	34.91	3.32
Carbon Monoxide (CO)	5.39	189.58	18.04
Particulates (as PM ₁₀)	0.57	20.00	1.90
Sulfur Dioxide (SO ₂)	0.01	0.23	0.02
Carbon Dioxide (GHG - CO ₂)	739	25,993	2,473
Nitrous Oxide (GHG - N ₂ O)	0.02	0.69	0.07
Methane (GHG - CH ₄)	0.04	1.50	0.14
Diesel Particulate Matter (DPM)	0.57	20.00	1.90
Fugitive Dust (as PM ₁₀)	1.43	28.10	2.81
Carbon Dioxide Equivalents (CO ₂ eq)	746	26,473	2,519

Project Emissions	Construction	
	tons	tonnes
Carbon Dioxide (GHG - CO ₂)	739	670
Nitrous Oxide (GHG - N ₂ O)	0.020	0.018
Methane (GHG - CH ₄)	0.043	0.039
Carbon Dioxide Equivalents (CO ₂ eq)	746	677

Notes:

tons – short tons (2,000 pounds)

tonnes – metric tons (1,000 kilograms or 2,204.6 pounds)

9. Offsite Emissions Summary

Project Emissions	Construction		
	tons	lb/day	lb/hr
Oxides of Nitrogen (as NO ₂)	0.47	9.23	2.33
Hydrocarbons (ROC as CH ₄)	0.07	1.32	0.35
Carbon Monoxide (CO)	1.09	21.43	5.64
Particulates (as PM ₁₀)	0.13	2.48	0.62
Sulfur Dioxide (SO ₂)	0.009	0.173	0.043
Carbon Dioxide (GHG - CO ₂)	126	2,467	617
Nitrous Oxide (GHG - N ₂ O)	0.0016	0.0320	0.0080
Methane (GHG - CH ₄)	0.0048	0.0942	0.0236
Diesel Particulate Matter (DPM)	0.0078	0.1533	0.0383
Fugitive Dust (as PM ₁₀)	3.33	65.38	16.34
Carbon Dioxide Equivalents (CO ₂ eq)	126	2,497	624

Project Emissions	Construction	
	tons	tonnes
Carbon Dioxide (GHG - CO ₂)	126	114
Nitrous Oxide (GHG - N ₂ O)	0.0016	0.0015
Methane (GHG - CH ₄)	0.0048	0.0044
Carbon Dioxide Equivalents (CO ₂ eq)	126	115

Notes:

tons – short tons (2,000 pounds)

tonnes – metric tons (1,000 kilograms or 2,204.6 pounds)

10. Total Project Summary

Project Emissions	Construction		
	tons	lb/day	lb/hr
Oxides of Nitrogen (as NO ₂)	9.55	328.52	32.71
Hydrocarbons (ROC as CH ₄)	1.06	36.23	3.67
Carbon Monoxide (CO)	6.48	211.02	23.68
Particulates (as PM ₁₀)	0.69	22.48	2.52
Sulfur Dioxide (SO ₂)	0.02	0.40	0.07
Carbon Dioxide (GHG - CO ₂)	865	28,460	3,090
Nitrous Oxide (GHG - N ₂ O)	0.02	0.73	0.07
Methane (GHG - CH ₄)	0.05	1.60	0.17
Diesel Particulate Matter (DPM)	0.58	20.15	1.94
Fugitive Dust (as PM ₁₀)	4.77	93.48	19.15
Carbon Dioxide Equivalents (CO ₂ eq)	872	28,970	3,143

Project Emissions	Construction		
	tons	tons CO ₂ e	tonnes
Carbon Dioxide (GHG - CO ₂)	865	865	784
Nitrous Oxide (GHG - N ₂ O)	0.021	6.62	0.019
Methane (GHG - CH ₄)	0.048	1.00	0.043
Carbon Dioxide Equivalents (CO ₂ eq)	872	872	791

Notes:

tons – short tons (2,000 pounds)

tonnes – metric tons (1,000 kilograms or 2,204.6 pounds)

Significance Criteria	Total Project	
	tons/yr	lb/day
Oxides of Nitrogen (as NO ₂)	15	80
Hydrocarbons (ROC as CH ₄)	15	80
Particulates (as PM ₁₀)	15	80
Carbon Monoxide (CO)	Violation of CAAQS for CO	

Reference:

Bay Area AQMD

BAAQMD CEQA Guidelines, Table 3

Significance Criteria	Total Project	
	tons/yr	lb/day
Oxides of Nitrogen (as NO ₂)	10	n/a
Hydrocarbons (ROC as CH ₄)	10	n/a
Carbon Monoxide (CO)	Violation of CAAQS for CO	

Reference:

San Joaquin Valley APCD

Guide for Assessing and Mitigating Air Quality Impacts, Table 4-1

11. Modeling Input

Pollutant	Construction	
	Hourly	Hourly
	lbs/hr	g/sec
Nitrogen Oxides (as NO ₂)	30.38	3.828
Sulfur Dioxide (SO ₂)	0.02	0.003
Carbon Monoxide (CO)	18.04	2.273
Particulates (as PM ₁₀)	1.90	0.240
Particulates (as PM _{2.5})*	1.88	0.237
Diesel Particulate Matter (DPM)	1.90	0.240
Fugitive Dust (as PM ₁₀)	2.81	0.354

Release Parameter	Units	Construction	DPM SR	Area Source
Fuel Usage	gal/hr	110	110	
Higher Heating Value	BTU/gal	137,030	137,030	
Heat Input	mmBTU/hr	15.1	15.1	
Fd Factor	wscf/mmBTU	10,320	10,320	
Release Flowrate	wscf/hr	551,039	551,039	
Release Flowrate	wacf/sec	365	365	
Release Flowrate	wacm/sec	10.3	10.3	
Unit Emission Rate	g/sec (g/m ² -sec)	1.0	1.0	7.9E-06
Release Height	meters	2.5	2.5	0
Release Diameter (side)	meters	0.541	0.541	211
Release Velocity	meters/sec	45.0	45.0	
Release Temperature	degrees K	700	700	
Ambient Temperature	degrees K	293	293	
Receptor Height	meters	1.5	1.5	1.5
Receptor Distance	meters	15 - 2000	15 - 2000	15 - 2000
Terrain Type	Simple/Complex	Simple	Simple	Simple
Dispersion Coefficient	Urban/Rural	Rural	Rural	Rural
Stability Class	A - F	D	D	D
Wind Speed	m/s	3.6	3.6	3.6
Distance to Receptor	meters	1000	1600	158
Stability Class	A - F	D	D	D
Ambient Concentration	ug/m ³	10.24	8.64	88.94

Notes:

* 99% of PM₁₀ for combustion sources, Appendix III, SCAQMD 2003 AQMP, Annual Average Emission Inventory

Construction 10 hour day is "worst case" impact scenario for combustion emissions & fugitive dust

Due to commutative properties using BAAQMD emission factor, fugitive dust impact is same for all spreads

Average wind speed for Stockton = 7.5 mph = 3.4 m/s

<http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgwind.html>

Fugitive dust (as PM₁₀) 51 lb/acre-day unmitigated, BAAQMD CEQA Guidelines, Section 3.3

Fugitive dust (as PM₁₀) 2.55 lb/acre-day mitigated

BAAQMD Ref: AP-42 Chapter 13.2.3 "Heavy Construction Operations"

Mitigation Ref: AP-42 Chapter 13.2.2 "Unpaved Roads", Figure 13.2.2-2

Soil moisture ratio = 5 (for all feasible mitigation measures)

12. Sheet Pile Model Results

Pollutant	Construction							
	Receptor	Stability	Unit Rate	Hourly	3-hour	8-hour	24-hour	Annual
	meters	Class	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³
Nitrogen Dioxide (as NO ₂)*	1000	D	10.24	6.3	5.6	4.4	1.25	0.14
Sulfur Dioxide (SO ₂)	1000	D	10.24	0.0	0.0	0.0	0.01	0.00
Carbon Monoxide (CO)	1000	D	10.24	23.3	20.9	16.3	4.66	0.52
Particulates (as PM ₁₀)	1000	D	10.24	2.5	2.2	1.7	0.49	0.05
Particulates (as PM _{2.5})	1000	D	10.24	2.4	2.2	1.7	0.49	0.05
Diesel Particulate Matter (DPM)	1600	D	8.64	2.1	1.9	1.5	0.41	0.05
Fugitive Dust (as PM ₁₀)	158	D		88.94	80.0	62.3	17.79	1.99

Averaging Period	EPA Factor	Adjusted Factor	Reasons & Remarks
3 hours	0.9	0.9	
8 hours	0.7	0.7	
24 hours	0.4	0.200	12 hours
Annual	0.08	0.0224	102 days
LST Ratio (SCAQMD)*		0.16	275 m

Reference:

Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (Revised)

EPA-454/R-92-019, pages 4-16.

24-hour and annual factors corrected for actual operating times and periods:

* NO₂ to NO_x ratio = 0.16 @ 275 m Figure 2-5, SCAQMD Localized Significance Threshold Methodology, June 2003

Diesel Particulate Preliminary Screening Health Risk Assessment

Pollutant	Annual	URV	Activity	Annual MEI	Cancer
	ug/m ³	(ug/m ³) ⁻¹	days	Correction	Risk
Diesel Particulate Matter (DPM)	0.05	3.00E-04	102	0.0040	5.5E-08

Reference:

Technical Support Document for Describing Available Cancer Potency Factors

California Environmental Protection Agency

Office of Environmental Health Hazard Assessment

Air Toxicology and Epidemiology Section

May 2005

13. Sheet Pile NAAQS Analysis

Construction								
Criteria Pollutant	Averaging Period	Modeled	Back-ground	Total	California Standard		Federal Standard	
		ug/m ³	ug/m ³	ug/m ³	ug/m ³	status	ug/m ³	status
Nitrogen Dioxide (NO ₂)	1-hour max	6.3	94	100	338	Under	---	Under
	Annual avg	0.1	19	19	56	Under	100	Under
Sulfur Dioxide (SO ₂)	1-hour max	0.0	59	59	655	Under	---	Under
	3-hour	0.0	53	53	---	Under	1309	Under
	24-hour	0.0	24	24	105	Under	367	Under
	Annual avg	0.0	7	7	---	Under	79	Under
Carbon Monoxide (CO)	1-hour max	23.3	1,946	1,969	22,898	Under	40,071	Under
	8-hour	16.3	1,488	1,504	10,304	Under	10,304	Under
Particulates (as PM ₁₀)	24-hour	0.49	84.0	84.5	50	Exceed	150	Under
	Annual avg	0.05	23.8	23.9	20	Exceed	---	Under
Particulates (as PM _{2.5})	24-hour	0.49	77.0	77.5	---	Under	35	Exceed
	Annual avg	0.05	13.3	13.4	12	Exceed	15	Under
Fugitive Dust (as PM ₁₀)	24-hour	17.79	84.0	101.8	50	Exceed	150	Under
	Annual avg	1.99	23.8	25.8	20	Exceed	---	Under

Notes:

Background reference is Bethel Island 2002-07 (Concord for PM_{2.5})

Combustion emissions maximum impact at 1000 m (3281 ft), point or volume source .

Fugitive dust maximum impact at 158 m (518 ft), area source.

Maximums	Period	ppm	ug/m ³	Data	2007	2006	2005	2004	2003	2002
Nitrogen Dioxide (NO ₂)	1-hour max	0.050	94	ppb	48	44	38	30	50	40
	Annual avg	0.010	19	ppb	8	8	7	8	9	10
Sulfur Dioxide (SO ₂)	1-hour max	0.023	59	ppb	13	18	15	15	15	23
	3-hour	0.020	53	ppb	11	16	14	14	14	20
	24-hour	0.009	24	ppb	5	7	6	6	6	9
	Annual avg	0.003	7	ppb	1.5	2.1	2.0	1.6	2.2	2.5
Carbon Monoxide (CO)	1-hour max	1.7	1,946	ppm	1.1	1.3	1.1	1.2	1.6	1.7
	8-hour	1.3	1,488	ppm	0.8	1.0	0.9	0.9	0.9	1.3
Particulates (as PM ₁₀)	24-hour	n/a	84.0	ug/m ₃	49.0	84.0	64.0	42.0	51.0	58.0
	Annual avg	n/a	23.8	ug/m ₃	18.8	19.4	18.5	19.5	19.4	23.8
Particulates (as PM _{2.5})	24-hour	n/a	77.0	ug/m ₃	46.2	62.1	48.9	74.0	50.0	77.0
	Annual avg	n/a	13.3	ug/m ₃	8.4	9.3	9.0	10.7	9.7	13.3

Reference:

BAAQMD - Bay Area Air Pollution Summaries 2002-07 (Bethel Island, Concord for PM_{2.5})

http://www.baaqmd.gov/pio/aaq_summaries/index.htm

Averaging Period	EPA Factor
3 hours	0.9
8 hours	0.7
24 hours	0.4
Annual	0.08

Reference:

Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (Revised)

EPA-454/R-92-019, pages 4-16.

14. Delta Air Quality

Pollutant	Period	Units	2007	2006	2005	2004	2003	2002
Ozone (O ₃)	1-hour max	ppbv	93	116	89	100	90	110
	8-hour max	ppbv	78	90	77	80	80	100
	3-year avg	ppbv	73	73	72	75	79	79
Nitrogen Dioxide (NO ₂)	1-hour max	ppbv	48	44	38	30	50	40
	Annual avg	ppbv	8	8	7	8	9	10
Sulfur Dioxide (SO ₂)	24-hour max	ppbv	5	7	6	6	6	9
	Annual avg	ppbv	1.5	2.1	2.0	1.6	2.2	2.5
Carbon Monoxide (CO)	1-hour max	ppmv	1.1	1.3	1.1	1.2	1.6	1.7
	8-hour max	ppmv	0.8	1.0	0.9	0.9	0.9	1.3
Particulates (as PM ₁₀)	24-hour max	ug/m ₃	49.0	84.0	64.0	42.0	51.0	58.0
	Annual avg	ug/m ₃	18.8	19.4	18.5	19.5	19.4	23.8
Particulates (as PM _{2.5})	24-hour max	ug/m ₃	46.2	62.1	48.9	74.0	50.0	77.0
	Annual avg	ug/m ₃	8.4	9.3	9.0	10.7	9.7	13.3

Pollutant	Period	Units	2007	2006	2005	2004	2003	2002
Ozone (O ₃)	1-hour max	ppmv	0.093	0.116	0.089	0.100	0.090	0.110
	8-hour max	ppmv	0.078	0.090	0.077	0.080	0.080	0.100
	3-year avg	ppmv	0.073	0.073	0.072	0.075	0.079	0.079
Nitrogen Dioxide (NO ₂)	1-hour max	ppmv	0.048	0.044	0.038	0.030	0.050	0.040
	Annual avg	ppmv	0.008	0.008	0.007	0.008	0.009	0.010
Sulfur Dioxide (SO ₂)	24-hour max	ppmv	0.005	0.007	0.006	0.006	0.006	0.009
	Annual avg	ppmv	0.002	0.002	0.002	0.002	0.002	0.003
Carbon Monoxide (CO)	1-hour max	ppmv	1.1	1.3	1.1	1.2	1.6	1.7
	8-hour max	ppmv	0.8	1.0	0.9	0.9	0.9	1.3
Particulates (as PM ₁₀)	24-hour max	ug/m ₃	49.0	84.0	64.0	42.0	51.0	58.0
	Annual avg	ug/m ₃	18.8	19.4	18.5	19.5	19.4	23.8
Particulates (as PM _{2.5})	24-hour max	ug/m ₃	46.2	62.1	48.9	74.0	50.0	77.0
	Annual avg	ug/m ₃	8.4	9.3	9.0	10.7	9.7	13.3

Reference:

BAAQMD, 2008 (Bethel Island, Concord for PM_{2.5})

http://www.baaqmd.gov/pio/aq_summaries/index.htm

Pollutant	Standard	Total	2007	2006	2005	2004	2003	2002
Ozone (O ₃)	Federal	4	0	1	0	0	0	3
	California	21	4	14	2	1	0	0
Particulates (as PM ₁₀)	Federal	0	0	0	0	0	0	0
	California	6	0	1	1	0	1	3
Particulates (as PM _{2.5})	Federal	17	7	5	0	1	0	4
	California	0	0	0	0	0	0	0

15. Ambient Air Standards

Species Name	Averaging Time	California Standards		Federal Standards	
		ppmv	ug/m ³	ppmv	ug/m ³
Ozone (O ₃)	1-hour	0.09	177	--	--
	8-hour	0.07	137	0.075	147
Nitrogen Dioxide (NO ₂)	1-hour	0.18	338	--	--
	Annual	0.03	56	0.053	100
Sulfur Dioxide (SO ₂)	1-hour	0.25	655	--	--
	3-hour (secondary)	--	--	0.50	1,309
	24-hour	0.04	105	0.14	367
	Annual	--	--	0.03	79
Carbon Monoxide (CO)	1-hour	20	22,898	35	40,071
	8-hour	9	10,304	9	10,304
	Lake Tahoe (8-hr)	6	6,869	--	--
Particulates (as PM ₁₀)	24-hour	--	50	--	150
	Annual	--	20	--	--
Particulates (as PM _{2.5})	24-hour	--	--	--	35
	Annual	--	12	--	15
Lead (Pb)	30-day	--	1.5	--	--
	90-day	--	--	--	1.5
Sulfates (as SO ₄)	24-hour	--	25	none	none
Hydrogen Sulfide (H ₂ S)	1-hour	0.03	42	none	none
Vinyl Chloride (C ₂ H ₃ Cl)	24-hour	0.01	26	none	none
Visibility Reducing Particles	8-hour	Extinction coefficient of 0.23 per km; visibility of 10 miles or more (0.07 to 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70%.		none	none

Notes:

Standard Temperature

25 deg C

Standard Molar Volume

24.465 liter/g-mole

For gases, ug/m³ calculated from ppmv based on molecular weight and standard conditions (not rounded)

Reference:

California Air Resources Board, 2008

16. Nonroad Tiered Factors

SIC 1629 Heavy Construction, not elsewhere classified
 PROCESS EQPT DESCRIPTION Diesel Engine, Nonroad Tiers
 FUEL TYPE/PROCESS INFO California Ultra Low Sulfur Diesel, 15 ppmw S
 TOTAL PROCESS RATE n/a mgal/yr
 MAXIMUM PROCESS RATE n/a mgal/day
 MAXIMUM PROCESS RATE n/a mgal/hr
 MAXIMUM DAILY SCHEDULE n/a hrs/day
 HEAT RATE 7000 BTU/bhp-hr

EMITTENT	Precontrol g/BHP-hr	Tier 1 (96) g/BHP-hr	Tier 2 (01) g/BHP-hr	Tier 3 (06) g/BHP-hr	Composite g/BHP-hr	Gasoline g/BHP-hr
Oxides of Nitrogen (as NO ₂)	14.0	6.9	4.2	2.6	6.4	5.2
Hydrocarbons (ROC as CH ₄)	1.1	1.0	0.6	0.4	0.7	9.1
Carbon Monoxide (CO)	3.0	8.5	2.6	2.6	3.8	199.1
Particulates (as PM ₁₀)	1.0	0.40	0.15	0.15	0.40	0.32
Sulfur Dioxide (SO ₂)	0.005	0.005	0.005	0.005	0.005	0.005
Carbon Dioxide (GHG - CO ₂)	521	521	521	521	521	489
Nitrous Oxide (GHG - N ₂ O)	0.013	0.013	0.013	0.013	0.013	0.013
Methane (GHG - CH ₄)	0.030	0.030	0.030	0.030	0.030	0.028

EMITTENT	Precontrol lb/mgal	Tier 1 (96) lb/mgal	Tier 2 (01) lb/mgal	Tier 3 (06) lb/mgal	Composite lb/mgal	Gasoline lb/mgal
Oxides of Nitrogen (as NO ₂)	604.2	297.8	181.3	112.2	276.2	202.8
Hydrocarbons (ROC as CH ₄)	47.5	43.2	25.9	17.3	30.2	354.9
Carbon Monoxide (CO)	129.5	366.8	112.2	112.2	164.0	7,764.9
Particulates (as PM ₁₀)	43.2	17.3	6.5	6.5	17.3	12.5
Sulfur Dioxide (SO ₂)	0.2	0.2	0.2	0.2	0.2	0.2
Carbon Dioxide (GHG - CO ₂)	22,485	22,485	22,485	22,485	22,485	19,071
Nitrous Oxide (GHG - N ₂ O)	0.6	0.6	0.6	0.6	0.6	0.5
Methane (GHG - CH ₄)	1.3	1.3	1.3	1.3	1.3	1.1

EMITTENT	Diesel g/kg fuel	Diesel lb/mmBTU	Diesel lb/mgal	Diesel g/mi	Gasoline g/mi
Carbon Dioxide (GHG - CO ₂)	3165	164	22,485	1,368	193.06
Nitrous Oxide (GHG - N ₂ O)	0.08	0.0041	0.56	0.0048	0.0051
Methane (GHG - CH ₄)	0.18	0.0093	1.29	0.0051	0.0168

Notes:

Nonroad Tier 1, 2, 3 per 40 CFR 89.112 & 13 CCR 2423

Precontrol NO_x, ROC, CO, PM₁₀ per AP-42 Table 3.3-1

Default heat rate = 7,000 BTU/BHP-hr (AP-42 Table 3.3-1)

SO₂ = 0.005 g/bhp-hr (15 ppmw S, 19300 BTU/lb, 7.1 lb/gal)

CO₂ = 521 g/bhp-hr (164 lb/mmBTU, AP-42 Table 3.3-1)

N₂O = 0.013 g/bhp-hr (0.08 g/kg fuel, Annex 3, Table A-101, US GHG Inventory, 19300 BTU/lb, 7.1 lb/gal)

CH₄ = 0.030 g/bhp-hr (0.18 g/kg fuel, Annex 3, Table A-101, US GHG Inventory, 19300 BTU/lb, 7.1 lb/gal)

Gasoline = 20,300 BTU/lb, 6.1 lb/gal (AP-42 Table 3.3-1)

Diesel = 19,300 BTU/lb, 7.1 lb/gal (AP-42 Table 3.3-1)

2010 engine age profile estimation based on Annex 3, Table A-101, Table A-84, US GHG Inventory

22% Precontrol (uncontrolled)

19% Tier 1

28% Tier 2

31% Tier 3

Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007, EPA 2009

17. Global Warming Potential

Greenhouse Gas	Lifetime	GWP
	years	100-year
Carbon Dioxide (CO ₂)	50-200	1
Methane (CH ₄)	9-15	21
Nitrous Oxide (N ₂ O)	120	310
HFC-23	264	11,700
HFC-125	33	2,800
HFC-134a	15	1,300
HFC-143a	48	3,800
HFC-152a	2	140
HFC-227ea	37	2,900
HFC-236fa	209	6,300
HFC-4310mee	17	1,300
Fluoromethane (CF ₄)	50,000	6,500
Fluoroethane (C ₂ F ₆)	10,000	9,200
Fluorobutane (C ₄ F ₁₀)	2,600	7,000
Fluorohexane (C ₆ F ₁₄)	3,200	7,400
Sulfur Hexafluoride (SF ₆)	3,200	23,900

References & Notes:

USEPA 2009

18. Ozone Depleter

Ozone Depleter	Direct	Net Effect	
	100-year	min	max
CFC-11	4,600	(600)	3,600
CFC-12	10,600	7,300	9,900
CFC-113	6,000	2,200	5,200
HCFC-22	1,700	1,400	1,700
HCFC-123	120	20	100
HCFC-124	620	480	590
HCFC-141b	700	(5)	570
HCFC-142b	2,400	1,900	2,300
Trichloromethane (CHCl ₃)	140	(560)	0
Carbon Tetrachloride (CCl ₄)	1,800	(3,900)	660
Methyl Bromide (CH ₃ Br)	5	(2,600)	(500)
Halon-1211	1,300	(24,000)	(3,600)
Halon-1301	6,900	(76,000)	(9,300)

References & Notes:

USEPA 2009

19. Global Rates of Change

Global Concentrations and Rates of Change

Atmospheric Variable	CO ₂	CH ₄	N ₂ O	SF ₆	CF ₄
	ppmv	ppmv	ppmv	pptv	pptv
Pre-industrial atmospheric concentration (1750)	278	0.70	0.270	0	40
Atmospheric concentration in 1998	365	1.75	0.314	4.20	80
Percent increase from pre-industrial to 1998	31%	150%	16%	n/a	100%
Rate of concentration change (units/decade)	1.5	0.007	0.0008	0.24	1
Estimated atmospheric concentration in 2008	366.5	1.757	0.3148	4.44	81
Percent increase from 1998 to 2008	0.41%	0.40%	0.25%	5.71%	1.25%
Atmospheric Lifetime (years)	50-200	9-15	120	3200	>50,000

References & Notes:

USEPA 2009

ppmv = parts per million by volume (10^{-6})

pptv = parts per trillion by volume (10^{-12})

Rate of change for decade 1990 to 1999

20. Dry Air Composition

Standard Composition of Dry Air

Principal Gas	Chemical Symbol	MW	Concentration	Mole	Fraction	MW
		g/mole	ppmv	fraction	percent	g/mole
Nitrogen	N ₂	28.014	780,805.00	0.78080500	78.080500	21.873471
Oxygen	O ₂	31.998	209,450.00	0.20945000	20.945000	6.701981
Argon	Ar	39.948	9,340.00	0.00934000	0.934000	0.373114
Carbon Dioxide	CO ₂	44.009	377.76	0.00037776	0.037776	0.016625
Neon	Ne	20.183	18.21	0.00001821	0.001821	0.000368
Helium	He	4.003	5.24	0.00000524	0.000524	0.000021
Methane	CH ₄	16.043	1.75	0.00000175	0.000175	0.000028
Krypton	Kr	83.800	1.14	0.00000114	0.000114	0.000096
Hydrogen	H ₂	2.016	0.50	0.00000050	0.000050	0.000001
Nitrous Oxide	N ₂ O	44.013	0.31	0.00000031	0.000031	0.000014
Xenon	Xe	31.300	0.09	0.00000009	0.000009	0.000003
Totals			1,000,000.00	1.00000000	100.000	28.966

References & Notes:

MW = molecular weight, g/mole

ppmv = parts per million by volume (10^{-6})

Universal Industrial Gases, Inc., <http://www.uigi.com/air.html>

USEPA 2009

Condensed Laboratory Handbook, E.I. du Pont de Nemours & Co., Inc., Wilmington, DE, 1971

Environmental Engineering – Analysis and Practice, B. H. Jennings, International Textbook Co., 1970

Carbon dioxide varies with uptake by removal mechanisms, 365 (IPCC) to 380 ppmv (UIG)