

APPENDIX G

**Air Quality Calculations
(Roberts Island Update)**

Equipment List

Table 3.3-4 Construction Estimated Equipment List			
Equipment Type	Mfr/Model	Quantity	Horsepower
Off Road Construction (onsite)			
Loader	CAT 966G	2	233
Forklift	CAT TH83	2	109
Excavator	CAT 330	2	268
On Road Vehicles (offsite)			
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
Marine Vessels and Equipment (onsite)			
DB 24 (with Amclyde 28 crane)	CAT 3412	1	525
Dump Scow 5 (hopper barge)	CAT 3208	2	210
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
Generator 25KW	Rental	4	35
Vibratory / Impact Hammer	APE 200/CAT C16	1	630
Flat Deck Material Barge	n/a	6	
Dredgings Disposal (offsite)			
Tugboat for Dredgings Barge	Charter	2	800
Offloading Crane	Rental	1	750
D6 Dozer	Caterpillar D6	1	200
Dredgings Barge	n/a	3	
Source: Dutra Group 2008 (updated 2009) (see Appendix G)			

Notes:

Equipment list per The Dutra Group, August 2008

Dredgings disposal added August 2009 per e-mails & permit info

Construction Schedule

Table 3.3-5 Construction Planning Estimate					
Project Activity	Schedule				
	hrs/day	days/wk	months	days	hours
Dredging (original plan)	24	7	0.23	7	168
Rock Placement	10	7	1.08	33	330
Pile Driving	10	7	2.10	64	640
Vessels Tending (concurrent)	12	7	2.40	73	876
Dredging (supplemental)	24	7	0.66	20	480
Dredgings Disposal (concurrent)	12	7	0.66	20	240
Totals	10	7	4.08	124	
Source: Dutra Group 2008 (updated 2009) (see Appendix G)					

Notes:

Construction schedule per The Dutra Group, August 2008

Updated schedule per M&N, September 2008

Dredgings disposal added August 2009 per e-mails & permit info

<u>Dredgings Disposal to Roberts Island</u>	<u>Value</u>	<u>Units</u>	<u>Remarks</u>
Barge transit, distance	50	miles RT	mapped
Barge transit, speed	5.75	mph	5 knots
Barge transit, time	8.7	hrs/trip	80% load
Barge transit, standby	3.3	hrs/trip	6% load
Barge transit, total time	12.0	hrs/trip	60% load
Minimum estimated material	19,000	cu yds	Min impact permit values
Probable estimated material	32,000	cu yds	per M&N e-mail 8/4/09
Maximum estimated material	54,000	cu yds	Max impact permit values (worst case)
Amount to Bacon Island	14,000	cu yds	Original plan (2,000 cu yds/day)
Amount to Roberts Island	40,000	cu yds	Supplemental (worst case)
Barge capacity	2,000	cu yds	per ENTRIX e-mail 8/24/09
No. of transits	20	trips	worst case (1 trip/day)
Total transit time	240	hours	worst case
Barge unloading, crane	240	hours	1 barge per 12-hour day
Barge unloading, dozer	240	hours	1 barge per 12-hour day

Construction 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	330	6	59	1,961
Forklift	2	109	25%	10	330	3	28	917
Excavator	2	268	25%	10	168	7	68	1,148
On Road Vehicles (offsite)								
Grove Boom Truck RT 522	1	150	25%	5	165	2	10	316
Flat Bed Truck	1	250	25%	5	165	3	16	526
Pick Up Truck	4	200	25%	5	165	10	51	1,683
Fuel/Service Truck	1	225	25%	5	165	3	14	473
Water Truck (3600 gallons)	1	400	25%	5	165	5	26	842
Marine Vessels and Equipment (onsite)								
DB 24 (with Amclyde 28 crane)	1	525	75%	24	648	20	482	13,013
Dump Scow 5 (hopper barge)	2	210	25%	24	168	5	129	900
CB 8 (with Bucyrus-Erie 88B crane)	1	365	75%	10	330	14	140	4,607
CB Doolittle (with Bucyrus-Erie 65D crane)	1	280	25%	10	640	4	36	2,285
Workboat	3	600	15%	12	876	14	165	12,063
Tugboat "Sarah Reed"	2	1700	15%	12	876	26	312	22,785
Generator 25KW	4	35	50%	10	640	4	36	2,285
Vibratory Hammer	1	630	50%	10	640	16	161	10,282
Dredgings Disposal (offsite)								
Tugboat for Dredgings Barge	2	800	60%	12	240	49	588	11,750
Offloading Crane	1	750	75%	12	240	29	344	6,885
D6 Dozer	1	200	50%	12	240	5	61	1,224
Onsite Preparation Maximum Totals (mgal)						0.032	0.679	15.061
Onsite Construction Maximum Totals (mgal)						0.110	1.054	61.025
Onsite Totals (mgal)								76.086
Offsite Preparation Maximum Totals (mgal)						0.083	0.993	19.859
Project Total (mgal)								95.945

Table 3.3-6 Estimated Maximum Fuel Consumption for Project			
Project Activity	Hourly gal/hr	Daily gal/day	Project gallons
Onsite Preparation	30	680	15,100
Offsite Preparation	80	990	19,900
Construction	110	1,050	61,000
Maximum Rates	110	1,050	96,000
Source: Dutra Group 2008 (updated 2009) (see Appendix G)			
Notes:			
BSFC = (7,000 BTU/BHP-hr) / (137,030 BTU/gal) = 0.051 gal/BHP-hr			
AP-42 Table 3.3-1 (EPA 2006)			

Onsite 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	76.086	mgal/yr
DAILY MAX PROCESS RATE	1.054	mgal/day
HOURLY MAX PROCESS RATE	0.110	mgal/hr
DAILY MAX SCHEDULE	10	hrs/day

EMITTENT	FACTOR	ANNUAL	ANNUAL	DAILY	HOURLY
	lb/mgal	lbs/yr	tons/yr	lbs/day	lbs/hr
Oxides of Nitrogen (as NO ₂)	276.2	21,015	10.51	291.1	30.35
Hydrocarbons (ROC as CH ₄)	30.2	2,298	1.15	31.8	3.32
Carbon Monoxide (CO)	164.0	12,478	6.24	172.9	18.02
Particulates (as PM ₁₀)	17.3	1,316	0.66	18.2	1.90
Sulfur Dioxide (SO ₂)	0.2	15	0.01	0.2	0.02
Carbon Dioxide (GHG - CO ₂)	22,485	1,710,786	855.39	23,699.1	2,471.09
Nitrous Oxide (GHG - N ₂ O)	0.6	46	0.02	0.6	0.07
Methane (GHG - CH ₄)	1.3	99	0.05	1.4	0.14
Diesel Particulate Matter (DPM)	17.3	1,316	0.66	18.2	1.90
Fugitive Dust (as PM ₁₀)		2,922	1.46	28.1	2.81

Notes:

Composite emission factors per Nonroad Tiered Factors

Offsite 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	19.859	mgal/yr
DAILY MAX PROCESS RATE	0.993	mgal/day
HOURLY MAX PROCESS RATE	0.083	mgal/hr
DAILY MAX SCHEDULE	12	hrs/day

EMITTENT	FACTOR	ANNUAL	ANNUAL	DAILY	HOURLY
	lb/mgal	lbs/yr	tons/yr	lbs/day	lbs/hr
Oxides of Nitrogen (as NO ₂)	276.2	5,485	2.74	274.3	22.92
Hydrocarbons (ROC as CH ₄)	30.2	600	0.30	30.0	2.51
Carbon Monoxide (CO)	164.0	3,257	1.63	162.9	13.61
Particulates (as PM ₁₀)	17.3	344	0.17	17.2	1.44
Sulfur Dioxide (SO ₂)	0.2	4	0.00	0.2	0.02
Carbon Dioxide (GHG - CO ₂)	22,485	446,528	223.26	22,327.5	1,866.25
Nitrous Oxide (GHG - N ₂ O)	0.6	12	0.01	0.6	0.05
Methane (GHG - CH ₄)	1.3	26	0.01	1.3	0.11
Diesel Particulate Matter (DPM)	17.3	344	0.17	17.2	1.44
Fugitive Dust (as PM ₁₀)		211	0.11	10.5	0.88

Notes:

Composite emission factors per Nonroad Tiered Factors

Fugitive Dust

Table 3.3-15 Estimated Fugitive Dust Emissions from Construction							
Sheet Pile	Area	Schedule	Control	Uncontrolled		Controlled	
	acres	days	percent	lbs/day	lbs/yr	lbs/day	lbs/yr
Bacon Island	4.13	104	95%	211	21,917	11	1,096
Holland Tract	4.13	104	95%	211	21,917	11	1,096
Connection Slough	2.75	104	95%	140	14,612	7	731
Onsite Totals	11.02	104		562	58,446	28	2,922
Roberts Island	4.13	20	95%	211	4,215	11	211
Offsite Totals	4.13	20		211	4,215	11	211
Sources: BAAQMD 1999, EPA 2006							
Notes:							
Fugitive dust (as PM ₁₀) 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							
Soil moisture ratio = 5 (for all feasible mitigation measures under project control)							
Roberts Island soil moisture ratio = 5 (for permitted mitigation measures)							

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	59520	992 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		636.4	0.318	5.13	1.28
Hydrocarbons (ROC as CH ₄)	0.081		10.6	0.005	0.09	0.02
Carbon Monoxide (CO)	0.902		118.3	0.059	0.95	0.24
Particulates (as PM ₁₀)	0.145		19.0	0.010	0.15	0.04
Sulfur Dioxide (SO ₂)	0.014		1.8	0.001	0.01	0.00
Carbon Dioxide (GHG - CO ₂)	1,368		179,367	90	1,447	362
Nitrous Oxide (GHG - N ₂ O)	0.0048		0.6	0.000	0.01	0.00
Methane (GHG - CH ₄)	0.0051		0.7	0.000	0.01	0.00
Diesel Particulate Matter (DPM)	0.145		19.0	0.010	0.15	0.04
Fugitive Dust (as PM ₁₀)	10		1,351	0.68	10.90	2.72

Notes:

Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, EPA 2008
 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)

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	297600	4960	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	507.9	0.254	4.10	1.04
Hydrocarbons (ROC as CH ₄)	0.22	0.79	152.8	0.076	1.23	0.33
Carbon Monoxide (CO)	3.66	12.85	2,539.5	1.270	20.48	5.40
Particulates (as PM ₁₀)	0.44		288.4	0.144	2.33	0.58
Sulfur Dioxide (SO ₂)	0.03		19.7	0.010	0.16	0.04
Carbon Dioxide (GHG - CO ₂)	193.06		126,552	63	1,021	255
Nitrous Oxide (GHG - N ₂ O)	0.0051		3.3	0.002	0.03	0.01
Methane (GHG - CH ₄)	0.0168		11.0	0.006	0.09	0.02
Diesel Particulate Matter (DPM)	0.000		0.0	0.000	0.00	0.00
Fugitive Dust (as PM ₁₀)	10		6,756	3.38	54.48	13.62

Notes:

Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, EPA 2008
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)

Onsite Summary

Table 3.3-10 Estimated Onsite Construction Criteria Emissions, Controlled			
Project Emissions	tons	lb/day	lb/hr
Oxides of Nitrogen (as NO ₂)	10.51	291.11	30.35
Hydrocarbons (ROC as CH ₄)	1.15	31.83	3.32
Carbon Monoxide (CO)	6.24	172.86	18.02
Particulates (as PM ₁₀)	0.66	18.23	1.90
Sulfur Dioxide (SO ₂)	0.01	0.21	0.02
Carbon Dioxide (GHG - CO ₂)	855	23,699	2,471
Nitrous Oxide (GHG - N ₂ O)	0.02	0.63	0.07
Methane (GHG - CH ₄)	0.05	1.37	0.14
Diesel Particulate Matter (DPM)	0.66	18.23	1.90
Fugitive Dust (as PM ₁₀)	1.46	28.10	2.81

Project Emissions	tons	tonnes
Carbon Dioxide (GHG - CO ₂)	855	776
Nitrous Oxide (GHG - N ₂ O)	0.023	0.021
Methane (GHG - CH ₄)	0.049	0.045
Carbon Dioxide Equivalents (CO ₂ eq)	864	783
Sources: EPA 2006, CARB 2006a, EPA 2009		
Notes:		
tons – short tons (2,000 pounds)		
tonnes – metric tons (1,000 kilograms or 2,204.6 pounds)		

Offsite Summary

Table 3.3-11 Estimated Offsite Construction Criteria Emissions, Controlled			
Project Emissions	tons	lb/day	lb/hr
Oxides of Nitrogen (as NO ₂)	3.31	283.49	25.25
Hydrocarbons (ROC as CH ₄)	0.38	31.31	2.85
Carbon Monoxide (CO)	2.96	184.29	19.25
Particulates (as PM ₁₀)	0.33	19.66	2.06
Sulfur Dioxide (SO ₂)	0.01	0.37	0.06
Carbon Dioxide (GHG - CO ₂)	376	24,795	2,483
Nitrous Oxide (GHG - N ₂ O)	0.01	0.63	0.06
Methane (GHG - CH ₄)	0.02	1.39	0.13
Diesel Particulate Matter (DPM)	0.18	17.33	1.47
Fugitive Dust (as PM ₁₀)	4.16	75.91	17.22

Project Emissions	tons	tonnes
Carbon Dioxide (GHG - CO ₂)	376	341
Nitrous Oxide (GHG - N ₂ O)	0.008	0.007
Methane (GHG - CH ₄)	0.019	0.017
Carbon Dioxide Equivalents (CO ₂ eq)	379	344
Sources: EPA 2006, CARB 2006a, EPA 2009		
Notes:		
tons – short tons (2,000 pounds)		
tonnes – metric tons (1,000 kilograms or 2,204.6 pounds)		

Total Project Summary

Table 3.3-12 Estimated Total Construction Criteria Emissions, Controlled			
Project Emissions	tons	lb/day	lb/hr
Oxides of Nitrogen (as NO ₂)	13.82	574.61	55.61
Hydrocarbons (ROC as CH ₄)	1.53	63.14	6.17
Carbon Monoxide (CO)	9.20	357.14	37.28
Particulates (as PM ₁₀)	0.98	37.89	3.96
Sulfur Dioxide (SO ₂)	0.02	0.58	0.08
Carbon Dioxide (GHG - CO ₂)	1,232	48,494	4,954
Nitrous Oxide (GHG - N ₂ O)	0.03	1.26	0.12
Methane (GHG - CH ₄)	0.07	2.76	0.27
Diesel Particulate Matter (DPM)	0.84	35.57	3.38
Fugitive Dust (as PM ₁₀)	5.62	104.01	20.03

Table 5-1 Estimated Total GHG Emissions During Construction		
Project Emissions	tons	tonnes
Carbon Dioxide (GHG - CO ₂)	1,232	1,117
Nitrous Oxide (GHG - N ₂ O)	0.031	0.028
Methane (GHG - CH ₄)	0.068	0.062
Carbon Dioxide Equivalents (CO ₂ eq)	1,243	1,127
Sources: EPA 2006, CARB 2006a, EPA 2009		
Notes:		
tons – short tons (2,000 pounds)		
tonnes – metric tons (1,000 kilograms or 2,204.6 pounds)		

Table 3.3-8 BAAQMD Thresholds of Significance		
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	
Source: BAAQMD CEQA Guidelines, Table 3 (BAAQMD 1999)		

Table 3.3-9 SJVAPCD Thresholds of Significance		
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	
Source: Guide for Assessing and Mitigating Air Quality Impacts, Table 4-1 (SJVAPCD)		

Modeling Input

Pollutant	Construction	
	Hourly	Hourly
	lbs/hr	g/sec
Nitrogen Oxides (as NO ₂)	30.35	3.825
Sulfur Dioxide (SO ₂)	0.02	0.003
Carbon Monoxide (CO)	18.02	2.271
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	550,538	550,538	
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	1.6	1.6	1.6
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	86.73

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)

Modeling 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	18.29	16.46	12.80	3.66	0.42
Sulfur Dioxide (SO ₂)	1000	D	10.24	0.03	0.03	0.02	0.01	0.00
Carbon Monoxide (CO)	1000	D	10.24	23.25	20.93	16.28	4.65	0.53
Particulates (as PM ₁₀)	1000	D	10.24	2.45	2.21	1.72	0.49	0.06
Particulates (as PM _{2.5})	1000	D	10.24	2.43	2.19	1.70	0.49	0.06
Diesel Particulate Matter (DPM)	1600	D	8.64	2.07	1.86	1.45	0.41	0.05
Fugitive Dust (as PM ₁₀)	158	D		86.73	78.06	60.71	17.35	1.98

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	0.0228	104 days
LST Ratio (SCAQMD)*		0.467	1000 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 per Figure 2-5, SCAQMD Localized Significance Threshold Methodology, June 2003

Table 3.3-14 Diesel Particulate Matter 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	104	0.0041	5.8E-08
Source: California EPA, Office of Environmental Health Hazard Assessment, 2005					
Notes:					
Sensitive receptor impact at 1600 m (5249 ft), point or volume source.					
ug/m ³ = micrograms per cubic meter					
URV = Unit Reference (Risk) Value					

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

NAAQS Analysis

Table 3.3-13 Estimated Onsite Construction Criteria Maximum Impacts, Controlled

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	18.3	94	112	338	Under	---	Under
	Annual avg	0.4	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	0.06	23.8	23.9	20	Exceed	---	Under
Particulates (as PM _{2.5})	24-hour	0.49	84.0	84.5	---	Under	35	Exceed
	Annual avg	0.06	13.3	13.4	12	Exceed	15	Under
Fugitive Dust (as PM ₁₀)	24-hour	17.35	84.0	101.3	50	Exceed	150	Under
	Annual avg	1.98	23.8	25.8	20	Exceed	---	Under

Source: BAAQMD 2008, CARB 2008

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.

ug/m³ = micrograms per cubic meter

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/air_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.

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

Table 3.3-1 Ambient Air Quality Summary for Bethel Island 2002 to 2007, Maximums

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

Source: BAAQMD 2008

Notes:

Bethel Island, Concord for PM_{2.5}

ppmv = parts per million by volume

ug/m³ = micrograms per cubic meter

Table 3.3-2 Ozone, PM₁₀ and PM_{2.5} Standard Violation Days for Bethel Island, 2002 to 2007

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

Source: BAAQMD 2008

Ambient Air Standards

Table 3.3-3 State and Federal Ambient Air Quality 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

Source: CARB 2008

Notes:

Standard Temperature25 deg C

Standard Molar Volume24.465 liter/g-mole

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

ppmv = parts per million by volume

ug/m³ = micrograms per cubic meter

Nonroad Tiered Factors

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
Diesel Particulate Matter (DPM)	1.00	0.40	0.15	0.15	0.40	0.00

Table 3.3-7 Tiered Nonroad Diesel Emission Factors, Pounds per 1000 Gallons

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
Diesel Particulate Matter (DPM)	43.2	17.3	6.5	6.5	17.3	0.0

Source: 40 CFR 89.112, 13 CCR 2423, EPA 2009, EPA 2006

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

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% Tier3

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

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

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: 1990-2006, EPA 2008

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

Sources: UIG 2008, USEPA 2009, du Pont 1971, Jennings 1970

Notes:

MW = molecular weight, g/mole

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

References:

USEPA GHG Inventory 2009

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

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

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

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

GHG Effects

100-Year Global Warming Potentials of Greenhouse Gases		
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

Source: EPA 2009

GHG Effects

Ozone Depleting Substances			
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)

Source: EPA 2009

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

Source: EPA 2009

Notes:

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

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

Rate of change for decade 1990 to 1999