APPENDIX A

AIR QUALITY AND GREENHOUSE GAS EMISSIONS MODEL OUTPUTS

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2002 Project Emission Calculations

TRUCK AND PASSENGER CAR EMISSIONS - OARB PROJECT

Distance traveled within the SF Air Basin 80 miles one-way to Gilroy
by Over-the-Road Trucks: 45 miles one-way to Tracy

2002 PROJECT

	Daily One-Way Trips	One-Way Trip (mi)	Emission Factors (g/mi)				Emissions (lb/day)				Emissions (tons/year)				Fuel	Emissions (lb/day)				Emissions (tons/yr)				Emissions Metric Tons
			ROG	CO	NOx	PM10	ROG	CO	NOx	PM10	ROG	CO	NOx	PM10	mi/gal	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	
Port Area																								
lntermodal Trucks	3180	0.5	1.27	11.91	7.66	0.37	8.9	83.5	53.7	2.6	1	11	7	0	19.77	5,000	0.36	2.3	5,700	650	0.0	0.3	740	671.18
Over-the-Road Trucks	1438	3.9	1.27	11.91	7.66	0.37	31.4	294.5	189.4	9.1	4	38	25	1	19.77	18,000	1	8	20,000	2,300	0.2	1.1	2,600	2358.2
Passenger Light Duty Autos	2662	18	0.37	2.24	0.22	0.04	78.2	473.3	46.5	8.5	10	62	6	1	28.36	150,000	3.2	70	171,000	19,500	0.4	9.1	22,200	20135.4
Passenger Light Duty Trucks	1036	18	0.68	3.51	0.33	0.04	55.9	288.6	27.1	3.3	7	38	4	0	17.56	58,000	2.3	27	66,000	7,500	0.3	3.5	8,600	7800.2
Gateway Development Area																								0
Passenger Light Duty Autos	14874	18	0.37	2.24	0.22	0.04	436.8	2644	259.7	47.2	57	344	34	6	28.36	839,000	18	391	956,000	109,100	2.3	50.9	124,300	112740.1
Passenger Light Duty Trucks	4958	18	0.68	3.51	0.33	0.04	267.6	1381	129.9	15.7	35	180	17	2	28.36	280,000	11	130	319,000	36,400	1.4	17	41,500	37640.5
lntermodal Trucks	198	1.8	1.27	11.91	7.66	0.37	2	18.7	12	0.6	0	2	2	0.08	0	1,000	0	1	1,160	130	0.0	0.1	160	145.12
16th and Wood Area																			0	0	0.0	0	0	0
Passenger Light Duty Autos	0	18	0.37	2.24	0.22	0.04	0	0	0	0	0	0	0	0	28.36	0	0	0	0	0	0.0	0	0	0
Passenger Light Duty Trucks	0	18	0.68	3.51	0.33	0.04	0	0	0	0	0	0	0	0	17.56	0	0.0	0	0	0	0.0	0	0	0
TOTAL TRUCKS:	28346						40.3	378	243.1	11.7	5	49	32	1	39.55	23000	1.64	10.52	25700	2950	0.2	1.4	3340	3029.38
TOTAL CARS:							572.9	3425	345.3	59.6	74	446	46	7.08	120.2	1048000	23.37	489.3	1194160	136230	3	63.6	155260	140820.82
Total Vehicles							613.2	3803	588.4	71.3	79	495	78	8.08	159.7	1071000	25.01	499.8	1219860	139180	3.2	65	158600	143850.2

1. assumption for vehicle mix for passenger cars: 75% Light Duty Auto, 25% Light Duty Truck
2. assumption for days operating per year: 260
3. assumption for fuel usage: average vehicle speed is 40 mph

liter= ###### gallon

JIT Line Haul and Switch Engine Emissions Associated with the OARB Project
PROJECT

Number of Trains per Day: a 2
Daily fuel use per train (gal): b 347.1
Annual fuel use per train (gal): b 1E+05

	Emission Factors (g/gal)[c]					Emissions (lb/day)					Emissions (tons/year)					Emissions (lb/day)				Emissions (tons/year)				
	ROG	CO	NOx	SO2[d]	PM10	ROG	CO	NOx	SO2[d]	PM10	ROG	CO	NOx	SO2[d]	PM10	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	
Line-Haul	5.4	26.6	103	16.33	3.6	8	41	158	25	6	2	7	29	5	1.00	1,088	0.33	0.51	1,000	199	0.08	0.09	182.000	165.074

a Source: Traffic analysis for the OARB EIR (Dowling Associates 2002).
b Source: JIT EIR (GAIA Consulting 1999).
c EPA 1997: Emission Factors for Locomotives (EPA420-F-97-051)- for engines manufactured after 2004 (Tier 2).
d From Berths 55-58 EIR (URS Greiner Woodward-Clyde 1998).

liter= 2.64E-01 gallon

Railyard Equipment Emissions Estimates

Container Throughput in 2010 (metric tons per year) 21.8

Container Throughput in 2020 (metric tons per year) 25.5

	Year 2010 Emissions (lbs/day) from the JIT EIR					Year 2010 Emissions (tons/year) from the JIT EIR					Emissions (lb/day)				Emissions (tons/yr)			
	CO	ROG	NOx	SO2	PM	CO	ROG	NOx	SO2	PM	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Rubber-Tired Gantry Crane	24.2	8.3	104.1	2.6	5	4	2	19	0	1	5,200	0.34	0.0081	5,210	950	0.062	0.0015	950
Side-Lift Piggy Packer	1.9	0.6	7.9	0.2	0.4	0	0	1	0	0	310	0.02	0.0005	310	60	0.004	0.0001	60
Hostling Tractor	25.2	7.9	80.8	2.2	5	5	1	15	0	1	4,900	0.32	0.0076	4,910	890	0.058	0.0014	890
IBC Tractor Lift	3.6	0.7	5.3	0.4	0.6	1	0	1	0	0	460	0.03	0.0007	460	80	0.005	0.0001	80
Mobile Car-Repair Crane	2.2	0.7	5.4	0.5	0.8	0	0	1	0	0	460	0.03	0.0007	460	80	0.005	0.0001	80
Mobile Car-Repair Truck	1	0	0	0	0	0	0	0	0	0	614	0.04	0.0010	620	110	0.007	0.0002	110
Supervisor Vehicle	0.8	0	0.1	0	0	0.14	0	0.01	0	0	614	0.04	0.0010	620	110	0.007	0.0002	110
Yard Van	1.7	0.1	0.2	0.1	0	0.3	0.01	0.03	0.01	0	614	0.04	0.0010	620	110	0.007	0.0002	110
Security Vehicle	2	0.1	0.1	0	0	0.36	0.01	0.02	0	0	614	0.04	0.0010	620	110	0.007	0.0002	110
Switch Engines	5	10	54	4	1.5	1	2	10	1	0.27	6,300	0.41	0.0098	6,310	1,150	0.075	0.0018	1,150
TOTAL:	68	28	258	10	13	12	5	47	1	2								

	Year 2020 Emissions (lbs/day)*					Year 2020 Emissions (tons/year)*					Emissions (lb/day)				Emissions (tons/yr)				
	CO	ROG	NOx	SO2	PM	CO	ROG	NOx	SO2	PM	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	MT
Rubber-Tired Gantry Crane	28	10	122	3	6	5	2	22	0	1.17	6083	0.398	0.0095	6,100	1,110	0.072	0.0017	1,110	1006.77
Side-Lift Piggy Packer	2	1	9	0	0	0	0	1	0	0.00	363	0.023	0.0006	360	70	0.004	0.0001	70	63.49
Hostling Tractor	29	9	95	3	6	6	1	18	0	1.17	5732	0.374	0.0089	5,740	1,040	0.068	0.0016	1,040	943.28
IBC Tractor Lift	4	1	6	0	1	1	0	1	0	0.00	538	0.035	0.0008	540	100	0.006	0.0002	100	90.7
Mobile Car-Repair Crane	3	1	6	1	1	0	0	1	0	0.00	538	0.035	0.0008	540	100	0.006	0.0002	100	90.7
Mobile Car-Repair Truck	1	0	0	0	0	0	0	0	0	0.00	718	0.047	0.0011	720	130	0.009	0.0002	130	117.91
Supervisor Vehicle	1	0	0	0	0	0	0	0	0	0.00	718	0.047	0.0011	720	130	0.009	0.0002	130	117.91
Yard Van	2	0	0	0	0	0	0	0	0	0.00	718	0.047	0.0011	720	130	0.009	0.0002	130	117.91
Security Vehicle	2	0	0	0	0	0	0	0	0	0.00	718	0.047	0.0011	720	130	0.009	0.0002	130	117.91
Switch Engines	6	12	63	5	2	1	2	12	1	0.32	7369	0.480	0.0114	7,380	1,340	0.087	0.0021	1,340	1215.38
TOTAL:	79	33	302	12	16	14	6	55	1	3					4,280	0.279	0.0067	4280	3881.96

• *JIT EIR emissions x yr 2020/yr 2010 container throughput ratio*

	Year 2020 Project Emissions (Year 2020 - JIT yr 2010) - lbs/day					Year 2020 Project Emissions (Year 2020 - JIT yr 2010) - tons/year					Emissions (lb/day)				Emissions (tons/yr)			
	CO	ROG	NOx	SO2	PM	CO	ROG	NOx	SO2	PM	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Rubber-Tired Gantry Crane	4	1	18	0	1	1	0	3	0	0	883	0.058	0.0014	880	161	0.011	0.00025	160
Side-Lift Piggy Packer	0	0	1	0	0	0	0	0	0	0	53	0.003	0.0001	53	10	0.0006	0.00001	10
Hostling Tractor	4	1	14	0	1	1	0	3	0	0	832	0.054	0.0013	830	151	0.01	0.00024	150
IBC Tractor Lift	1	0	1	0	0	0	0	0	0	0	78	0.005	0.0001	78	14	0.0009	0.00002	14
Mobile Car-Repair Crane	0	0	1	0	0	0	0	0	0	0	78	0.005	0.0001	78	14	0.0009	0.00002	14
Mobile Car-Repair Truck	0	0	0	0	0	0	0	0	0	0	104	0.007	0.0002	104	19	0.0012	0.00003	19
Supervisor Vehicle	0	0	0	0	0	0	0	0	0	0	104	0.007	0.0002	104	19	0.0012	0.00003	19
Yard Van	0	0	0	0	0	0	0	0	0	0	104	0.007	0.0002	104	19	0.0012	0.00003	19
Security Vehicle	0	0	0	0	0	0	0	0	0	0	104	0.007	0.0002	104	19	0.0012	0.00003	19
Switch Engines	1	2	9	1	0	0	0	2	0	0	1069	0.070	0.0017	1,070	195	0.013	0.0003	195
TOTAL:	11	5	44	2	2	2	1	8	0	0								

approximated from CH4 emissions using construction equipment emissions factors listed to lower left.

EF for all construction equipment (gm/mile)			
	CO_2	CH_4	N_2O
	3,090	0.2012	0.0048

Title : Bay Area AQMD Avg Annual CYr 2002
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2012/04/20 15:31:09
Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
Season : Annual
Area : Bay Area AQMD
****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	2.737	10.763	0	0	0.549
5	1.312	1.456	1.407	7.097	3.674	6.42	1.594
10	0.887	0.996	0.935	4.32	2.557	5.042	1.069
15	0.63	0.714	0.651	2.479	1.852	4.145	0.744
20	0.469	0.536	0.473	1.525	1.395	3.568	0.547
25	0.366	0.422	0.362	1.193	1.093	3.218	0.43
30	0.3	0.348	0.29	0.956	0.889	3.04	0.354
35	0.258	0.301	0.244	0.79	0.752	3.011	0.306
40	0.233	0.272	0.215	0.68	0.66	3.124	0.277
45	0.222	0.259	0.199	0.618	0.602	3.397	0.265
50	0.221	0.259	0.193	0.598	0.57	3.87	0.266
55	0.232	0.271	0.197	0.617	0.56	4.617	0.281
60	0.255	0.298	0.212	0.673	0.572	5.765	0.312
65	0.296	0.345	0.24	0.766	0.605	7.533	0.365

Pollutant Name: Carbon Monoxide Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	17.154	47.841	0	0	2.794
5	13.057	17.335	15.969	45.086	31.32	51.836	16.019
10	10.732	14.085	12.214	31.102	20.239	42.552	12.833

15	9.1	11.828	9.796	22.445	13.864	36.774	10.666
20	7.919	10.217	8.18	16.96	10.065	33.453	9.149
25	7.05	9.049	7.071	13.535	7.742	32.034	8.071
30	6.407	8.202	6.301	11.248	6.31	32.291	7.3
35	5.94	7.604	5.776	9.741	5.448	34.268	6.763
40	5.623	7.215	5.443	8.816	4.983	38.291	6.424
45	5.444	7.021	5.281	8.375	4.826	45.057	6.271
50	5.41	7.03	5.29	8.388	4.951	55.839	6.317
55	5.547	7.281	5.496	8.891	5.378	72.888	6.605
60	5.909	7.85	5.96	9.99	6.186	100.214	7.219
65	6.596	8.881	6.795	11.893	7.535	145.133	8.32

Pollutant Name: Oxides of Nitrogen Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	3.125	63.323	0	0	2.314
5	1.244	1.999	2.359	29.12	45.189	1.199	2.642
10	1.078	1.711	2.041	21.465	34.695	1.249	2.144
15	0.958	1.504	1.816	16.826	28.016	1.301	1.817
20	0.871	1.357	1.658	15.02	23.784	1.355	1.635
25	0.81	1.254	1.551	14.439	21.218	1.411	1.532
30	0.769	1.185	1.484	14.121	19.882	1.468	1.467
35	0.744	1.145	1.451	14.039	19.561	1.526	1.434
40	0.733	1.13	1.447	14.19	20.201	1.585	1.43
45	0.736	1.137	1.472	14.587	21.897	1.645	1.455
50	0.751	1.168	1.528	15.266	24.92	1.706	1.511
55	0.781	1.224	1.62	16.291	29.785	1.767	1.603
60	0.828	1.312	1.757	17.769	37.407	1.829	1.742
65	0.895	1.438	1.952	19.867	49.385	1.891	1.945

Pollutant Name: Carbon Dioxide Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	695.271	4516.17	0	0	198.412
5	987.665	1166.82	1675.95	2555.58	2778.3	216.993	1149.36
10	746.799	883.483	1247.04	2123.91	2708.68	185.361	876.528

15	586.121	694.474	968.131	1810.29	2667.56	160.945	694.189
20	477.468	566.663	783.27	1596.25	2642.52	142.038	571.083
25	403.695	479.882	659.699	1503.79	2626.96	127.41	489.377
30	354.231	421.697	577.846	1435.38	2617.27	116.173	434.447
35	322.567	384.449	525.95	1385.42	2611.44	107.687	399.11
40	304.809	363.56	497.118	1350.86	2608.37	101.498	379.088
45	298.879	356.585	487.73	1330.2	2607.52	97.302	372.106
50	304.1	362.727	496.651	1323.02	2608.75	94.914	377.429
55	321.068	382.686	524.991	1329.91	2612.27	94.263	395.718
60	351.764	418.795	576.352	1352.63	2618.7	95.393	429.163
65	399.948	475.475	657.62	1394.58	2629.28	98.482	481.924

Pollutant Name: Sulfur Dioxide Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0.022	0.363	0	0	0.014
5	0.014	0.017	0.026	0.185	0.232	0.004	0.023
10	0.011	0.013	0.02	0.161	0.231	0.004	0.018
15	0.009	0.011	0.016	0.141	0.231	0.003	0.015
20	0.007	0.009	0.013	0.127	0.23	0.003	0.013
25	0.006	0.008	0.011	0.122	0.23	0.003	0.011
30	0.005	0.007	0.01	0.118	0.23	0.002	0.011
35	0.005	0.006	0.009	0.115	0.23	0.002	0.01
40	0.005	0.006	0.009	0.113	0.23	0.002	0.01
45	0.004	0.006	0.009	0.111	0.23	0.003	0.009
50	0.005	0.006	0.009	0.11	0.23	0.003	0.01
55	0.005	0.006	0.009	0.11	0.23	0.003	0.01
60	0.005	0.007	0.01	0.111	0.23	0.004	0.01
65	0.006	0.007	0.011	0.112	0.23	0.005	0.011

Pollutant Name: PM10 Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0.06	1.828	0	0	0.065
5	0.045	0.068	0.073	1.953	1.097	0.068	0.121
10	0.03	0.046	0.049	1.379	0.795	0.053	0.084

15	0.021	0.033	0.035	0.96	0.597	0.044	0.059
20	0.016	0.024	0.026	0.709	0.464	0.038	0.044
25	0.012	0.019	0.021	0.597	0.374	0.035	0.036
30	0.01	0.016	0.017	0.51	0.312	0.033	0.03
35	0.009	0.013	0.014	0.446	0.269	0.032	0.026
40	0.008	0.012	0.013	0.403	0.241	0.034	0.023
45	0.007	0.011	0.012	0.38	0.223	0.037	0.022
50	0.007	0.011	0.012	0.376	0.214	0.041	0.022
55	0.007	0.011	0.012	0.391	0.213	0.049	0.022
60	0.008	0.012	0.012	0.424	0.219	0.061	0.024
65	0.009	0.014	0.014	0.476	0.234	0.08	0.027

Pollutant Name: PM10 - Tire Wear Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0	0	0	0	0
5	0.008	0.008	0.009	0.02	0.008	0.004	0.008
10	0.008	0.008	0.009	0.02	0.008	0.004	0.008
15	0.008	0.008	0.009	0.02	0.008	0.004	0.008
20	0.008	0.008	0.009	0.02	0.008	0.004	0.008
25	0.008	0.008	0.009	0.02	0.008	0.004	0.008
30	0.008	0.008	0.009	0.02	0.008	0.004	0.008
35	0.008	0.008	0.009	0.02	0.008	0.004	0.008
40	0.008	0.008	0.009	0.02	0.008	0.004	0.008
45	0.008	0.008	0.009	0.02	0.008	0.004	0.008
50	0.008	0.008	0.009	0.02	0.008	0.004	0.008
55	0.008	0.008	0.009	0.02	0.008	0.004	0.008
60	0.008	0.008	0.009	0.02	0.008	0.004	0.008
65	0.008	0.008	0.009	0.02	0.008	0.004	0.008

Pollutant Name: PM10 - Brake Wear Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0	0	0	0	0
5	0.013	0.013	0.013	0.019	0.013	0.006	0.013
10	0.013	0.013	0.013	0.019	0.013	0.006	0.013

15	0.013	0.013	0.013	0.019	0.013	0.006	0.013
20	0.013	0.013	0.013	0.019	0.013	0.006	0.013
25	0.013	0.013	0.013	0.019	0.013	0.006	0.013
30	0.013	0.013	0.013	0.019	0.013	0.006	0.013
35	0.013	0.013	0.013	0.019	0.013	0.006	0.013
40	0.013	0.013	0.013	0.019	0.013	0.006	0.013
45	0.013	0.013	0.013	0.019	0.013	0.006	0.013
50	0.013	0.013	0.013	0.019	0.013	0.006	0.013
55	0.013	0.013	0.013	0.019	0.013	0.006	0.013
60	0.013	0.013	0.013	0.019	0.013	0.006	0.013
65	0.013	0.013	0.013	0.019	0.013	0.006	0.013

Pollutant Name: Gasoline - mi/gal Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0	0	0	0	0
5	8.773	7.302	5.141	3.237	3.152	27.862	8.084
10	11.591	9.648	6.87	4.866	4.738	33.107	10.67
15	14.755	12.282	8.841	6.924	6.745	38.288	13.572
20	18.099	15.067	10.954	9.327	9.088	43.112	16.641
25	21.397	17.812	13.063	11.891	11.593	47.24	19.666
30	24.382	20.297	14.988	14.351	13.999	50.307	22.403
35	26.783	22.293	16.542	16.394	16.002	51.951	24.6
40	28.361	23.603	17.559	17.726	17.314	51.859	26.036
45	28.949	24.087	17.922	18.141	17.732	49.829	26.556
50	28.481	23.69	17.588	17.572	17.188	45.848	26.1
55	27.004	22.454	16.597	16.11	15.768	40.157	24.715
60	24.672	20.506	15.061	13.978	13.691	33.278	22.544
65	21.716	18.039	13.146	11.479	11.25	25.945	19.806

Pollutant Name: Diesel - mi/gal Temperature: 50F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0	0	0	0	0
5	27.468	28.908	19.774	4.846	3.597	0	11.5
10	27.468	28.908	19.774	5.102	3.597	0	11.657

15	27.468	28.908	19.774	5.419	3.597	0	11.851
20	27.468	28.908	19.774	5.752	3.597	0	12.055
25	27.468	28.908	19.774	5.897	3.597	0	12.143
30	27.468	28.908	19.774	6.035	3.597	0	12.227
35	27.468	28.908	19.774	6.16	3.597	0	12.304
40	27.468	28.908	19.774	6.266	3.597	0	12.369
45	27.468	28.908	19.774	6.347	3.597	0	12.418
50	27.468	28.908	19.774	6.396	3.597	0	12.448
55	27.468	28.908	19.774	6.41	3.597	0	12.456
60	27.468	28.908	19.774	6.387	3.597	0	12.442
65	27.468	28.908	19.774	6.33	3.597	0	12.408

Title : Bay Area AQMD Avg Annual CYr 2002
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2012/04/20 15:31:09
Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
Season : Annual
Area : Bay Area AQMD
****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 2: Starting Emissions (grams/trip)

Pollutant Name: Reactive Org Gases Temperature: 50F Relative Humidity: ALL

Time min	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
5	0.363	0.369	0.641	2.152	0.282	2.979	0.509
10	0.571	0.583	0.983	2.540	0.369	3.033	0.739
20	0.959	0.983	1.621	3.297	0.533	3.208	1.171
30	1.309	1.343	2.198	4.029	0.686	3.467	1.565
40	1.621	1.665	2.712	4.737	0.826	3.813	1.919
50	1.894	1.947	3.165	5.419	0.954	4.244	2.234
60	2.114	2.176	3.528	5.901	1.050	4.465	2.484

120	2.168	2.100	2.833	3.918	0.657	2.776	2.307
180	1.513	1.549	2.538	4.197	0.702	2.970	1.773
240	1.601	1.640	2.688	4.472	0.745	3.203	1.879
300	1.688	1.728	2.833	4.742	0.788	3.436	1.983
360	1.772	1.815	2.975	5.007	0.829	3.669	2.083
420	1.853	1.899	3.113	5.267	0.870	3.900	2.182
480	1.933	1.980	3.247	5.523	0.909	4.132	2.278
540	2.010	2.060	3.377	5.773	0.948	4.362	2.371
600	2.084	2.137	3.503	6.019	0.986	4.593	2.461
660	2.157	2.211	3.625	6.260	1.023	4.822	2.549
720	2.227	2.284	3.744	6.497	1.058	5.051	2.635

Pollutant Name: Carbon Monoxide Temperature: 50F Relative Humidity: ALL

Time min	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
5	2.881	3.310	6.907	18.134	2.555	6.648	4.239
10	4.990	5.808	12.110	24.985	4.174	6.530	6.979
20	8.959	10.510	21.881	37.940	7.215	6.385	12.139
30	12.595	14.818	30.806	49.897	9.995	6.360	16.870
40	15.899	18.733	38.884	60.857	12.513	6.455	21.172
50	18.872	22.255	46.117	70.819	14.770	6.671	25.046
60	21.512	25.385	52.503	79.783	16.766	7.008	28.492
120	24.682	27.035	35.705	48.335	8.817	7.737	27.520
180	16.393	19.207	31.836	54.318	9.436	10.154	20.636
240	17.230	20.171	33.398	59.829	10.022	12.865	21.849
300	18.028	21.091	34.900	64.869	10.576	15.264	22.994
360	18.787	21.965	36.342	69.437	11.097	17.351	24.070
420	19.507	22.796	37.724	73.534	11.586	19.125	25.076
480	20.188	23.581	39.046	77.160	12.042	20.587	26.014
540	20.830	24.322	40.308	80.314	12.467	21.737	26.884
600	21.432	25.019	41.510	82.997	12.858	22.575	27.684
660	21.995	25.671	42.651	85.208	13.218	23.101	28.415
720	22.520	26.278	43.733	86.948	13.545	23.314	29.078

Pollutant Name: Oxides of Nitrogen Temperature: 50F Relative Humidity: ALL

Time min	LDA	LDT	MDT	HDT	UBUS	MCY	ALL

5	0.335	0.471	0.827	1.078	0.239	0.272	0.459
10	0.435	0.600	1.160	1.556	0.354	0.299	0.608
20	0.611	0.827	1.747	2.396	0.557	0.349	0.871
30	0.755	1.013	2.225	3.081	0.722	0.391	1.087
40	0.868	1.159	2.597	3.613	0.850	0.426	1.254
50	0.949	1.263	2.860	3.990	0.940	0.455	1.374
60	0.998	1.327	3.016	4.213	0.994	0.476	1.446
120	1.032	1.388	3.106	4.315	1.017	0.494	1.497
180	1.093	1.460	3.147	4.293	1.013	0.483	1.554
240	1.085	1.450	3.128	4.262	1.006	0.468	1.543
300	1.074	1.435	3.101	4.220	0.998	0.450	1.528
360	1.060	1.417	3.067	4.169	0.987	0.428	1.509
420	1.042	1.393	3.025	4.107	0.975	0.403	1.485
480	1.022	1.366	2.977	4.035	0.960	0.374	1.457
540	0.999	1.335	2.921	3.954	0.943	0.341	1.425
600	0.972	1.299	2.858	3.862	0.924	0.305	1.389
660	0.943	1.259	2.788	3.760	0.903	0.265	1.349
720	0.911	1.215	2.711	3.649	0.880	0.221	1.305

Pollutant Name: Carbon Dioxide Temperature: 50F Relative Humidity: ALL

Time min	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
5	10.230	12.269	15.872	20.565	2.537	28.606	12.039
10	13.941	16.327	22.759	25.349	3.381	31.244	16.178
20	21.479	24.633	36.626	34.775	5.048	36.374	24.577
30	29.175	33.195	50.615	44.011	6.688	41.308	33.136
40	37.028	42.013	64.727	53.058	8.300	46.047	41.857
50	45.038	51.085	78.961	61.915	9.884	50.590	50.739
60	53.204	60.413	93.318	70.583	11.440	54.937	59.782
120	97.274	113.102	165.820	109.003	18.274	75.239	108.357
180	112.149	130.196	192.002	121.011	20.757	76.093	124.596
240	126.393	146.633	216.930	132.312	23.094	76.899	140.143
300	140.008	162.413	240.606	142.906	25.284	77.658	154.999
360	152.993	177.535	263.030	152.794	27.328	78.371	169.163
420	165.348	192.001	284.201	161.975	29.226	79.036	182.636
480	177.073	205.810	304.119	170.449	30.977	79.654	195.417
540	188.168	218.961	322.785	178.217	32.582	80.225	207.507
600	198.633	231.455	340.198	185.278	34.041	80.749	218.905
660	208.469	243.292	356.359	191.632	35.353	81.225	229.612

720	217.674	254.472	371.267	197.279	36.519	81.655	239.628

Pollutant Name: Sulfur Dioxide Temperature: 50F Relative Humidity: ALL

Time min	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
5	0.000	0.000	0.000	0.001	0.000	0.001	0.000
10	0.000	0.000	0.001	0.001	0.000	0.001	0.000
20	0.001	0.001	0.001	0.001	0.000	0.001	0.001
30	0.001	0.001	0.001	0.002	0.000	0.001	0.001
40	0.001	0.001	0.002	0.002	0.000	0.001	0.001
50	0.001	0.001	0.002	0.003	0.001	0.001	0.001
60	0.001	0.002	0.003	0.003	0.001	0.001	0.002
120	0.002	0.002	0.003	0.003	0.000	0.001	0.002
180	0.002	0.002	0.004	0.003	0.001	0.001	0.002
240	0.002	0.003	0.004	0.003	0.001	0.002	0.003
300	0.002	0.003	0.004	0.004	0.001	0.002	0.003
360	0.003	0.003	0.005	0.004	0.001	0.002	0.003
420	0.003	0.003	0.005	0.004	0.001	0.002	0.003
480	0.003	0.004	0.005	0.004	0.001	0.002	0.003
540	0.003	0.004	0.006	0.005	0.001	0.002	0.004
600	0.003	0.004	0.006	0.005	0.001	0.002	0.004
660	0.004	0.004	0.006	0.005	0.001	0.002	0.004
720	0.004	0.004	0.006	0.005	0.001	0.002	0.004

Pollutant Name: PM10 Temperature: 50F Relative Humidity: ALL

Time min	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
5	0.001	0.001	0.001	0.002	0.000	0.017	0.001
10	0.001	0.002	0.002	0.002	0.000	0.015	0.002
20	0.002	0.004	0.004	0.002	0.000	0.012	0.003
30	0.003	0.005	0.005	0.003	0.001	0.009	0.004
40	0.004	0.006	0.006	0.003	0.001	0.007	0.005
50	0.005	0.008	0.008	0.004	0.001	0.005	0.006
60	0.006	0.009	0.009	0.004	0.001	0.004	0.007
120	0.008	0.012	0.012	0.006	0.001	0.011	0.010
180	0.008	0.013	0.013	0.007	0.002	0.018	0.010

240	0.009	0.014	0.013	0.007	0.002	0.023	0.011
300	0.009	0.014	0.014	0.008	0.002	0.029	0.011
360	0.009	0.015	0.014	0.008	0.002	0.033	0.012
420	0.010	0.015	0.015	0.009	0.002	0.037	0.012
480	0.010	0.016	0.015	0.009	0.002	0.040	0.012
540	0.010	0.016	0.016	0.010	0.002	0.042	0.013
600	0.011	0.017	0.016	0.010	0.002	0.044	0.013
660	0.011	0.017	0.017	0.010	0.002	0.045	0.014
720	0.011	0.017	0.017	0.010	0.002	0.045	0.014

Title : Bay Area AQMD Avg Annual CYr 2002
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2012/04/20 15:31:09
Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
Season : Annual
Area : Bay Area AQMD
****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 4: Hot Soak Emissions (grams/trip)

Pollutant Name: Reactive Org Gases Temperature: 50F Relative Humidity: ALL

Time min	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
5	0.077	0.068	0.042	0.025	0.021	0.257	0.070
10	0.142	0.126	0.078	0.046	0.039	0.474	0.129
20	0.242	0.215	0.134	0.078	0.067	0.807	0.220
30	0.311	0.278	0.174	0.101	0.086	1.035	0.283
40	0.336	0.301	0.189	0.109	0.092	1.118	0.306

Hot soak results are scaled to reflect zero emissions for trip lengths of less than 5 minutes (about 25% of in-us

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Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2012/04/20 15:31:09
Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
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Area : Bay Area AQMD
****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 5a: Partial Day Diurnal Loss Emissions (grams/hour)

Pollutant Name: Reactive Org Gases Temperature: ALL Relative Humidity: ALL

Temp degF	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
50	0.013	0.012	0.006	0.001	0.000	0.022	0.012

Title : Bay Area AQMD Avg Annual CYr 2002
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2012/04/20 15:31:09
Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
Season : Annual
Area : Bay Area AQMD
****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 5b: Multi-Day Diurnal Loss Emissions (grams/hour)

Pollutant Name: Reactive Org Gases Temperature: ALL Relative Humidity: ALL

Temp degF	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
50	0.001	0.001	0.000	0.000	0.000	0.001	0.001

Title : Bay Area AQMD Avg Annual CYr 2002
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2012/04/20 15:31:09
Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
Season : Annual
Area : Bay Area AQMD
****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 6a: Partial Day Resting Loss Emissions (grams/hour)

Pollutant Name: Reactive Org Gases Temperature: ALL Relative Humidity: ALL

Temp degF	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
50	0.011	0.010	0.004	0.001	0.000	0.017	0.010

Title : Bay Area AQMD Avg Annual CYr 2002
Version : Emfac2007 V2.3 Nov 1 2006

Run Date : 2012/04/20 15:31:09
Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
Season : Annual
Area : Bay Area AQMD
****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 6b: Multi-Day Resting Loss Emissions (grams/hour)

Pollutant Name: Reactive Org Gases Temperature: ALL Relative Humidity: ALL

Temp degF	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
50	0.001	0.001	0.000	0.000	0.000	0.001	0.001

Title : Bay Area AQMD Avg Annual CYr 2002
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2012/04/20 15:31:09
Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
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Area : Bay Area AQMD
****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 7: Estimated Travel Fractions

Pollutant Name: Temperature: ALL Relative Humidity: ALL

LDA	LDT	MDT	HDT	UBUS	MCY	ALL

%VMT	0.555	0.332	0.071	0.033	0.003	0.006	1.000
%TRIP	0.552	0.297	0.087	0.056	0.001	0.008	1.000
%VEH	0.583	0.313	0.057	0.021	0.001	0.025	1.000

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Scen Year: 2002 -- All model years in the range 1965 to 2002 selected
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****

Year: 2002 -- Model Years 1965 to 2002 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

District Average District Average Bay Area AQMD

Table 8: Evaporative Running Loss Emissions (grams/minute)

Pollutant Name: Reactive Org Gases Temperature: 50F Relative Humidity: ALL

Time min	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
1	0.059	0.345	0.175	0.137	0.092	0.384	0.167
2	0.073	0.194	0.101	0.087	0.055	0.414	0.118
3	0.082	0.147	0.078	0.072	0.043	0.431	0.104
4	0.087	0.124	0.067	0.064	0.038	0.441	0.099
5	0.091	0.111	0.062	0.060	0.034	0.450	0.097
10	0.102	0.092	0.055	0.052	0.027	0.483	0.096
15	0.108	0.093	0.059	0.050	0.026	0.506	0.099
20	0.112	0.099	0.064	0.050	0.025	0.527	0.104
25	0.116	0.106	0.071	0.050	0.025	0.547	0.110
30	0.117	0.107	0.071	0.051	0.025	0.549	0.110
35	0.117	0.107	0.071	0.051	0.025	0.550	0.110
40	0.117	0.107	0.071	0.051	0.025	0.551	0.110
45	0.117	0.107	0.071	0.051	0.025	0.552	0.111
50	0.116	0.107	0.071	0.051	0.025	0.544	0.110
55	0.113	0.107	0.071	0.051	0.025	0.532	0.108

60	0.111	0.107	0.071	0.051	0.025	0.522	0.107

Calculate CO2 emissions from fossil fuel combustion

Emission factor (Kg CO_2/unit) = {Default carbon content * Oxidation factor * Default Net calorific value * Carbon molecule mass ratio (44/12) * F

Fuel (Litres / kg)	Default carbon content (Kg/GJ)	Oxidation factor	Net calorific value (TJ/Gg)	Carbon molecule mass ratio	Fuel density (Kg/Litre)	emission factor (gram/Litre)
Diesel	20.2	1	43	44/12	0.845	2691.212
Petrol	18.9	1	44.3	44/12	0.775	2379.242

The references for various values taken in the table above are;

1. Default carbon content in each of the fuel came from the table 1.3, Chapter 1, Volume 2 of IPCC Guidelines for National GHG Inventories 2006.
2. Default oxidation factor in each of the fuel came from the table 1.4, Chapter 1, Volume 2 of IPCC Guidelines for National GHG Inventories 2006.
3. Default net calorific value in each of the fuel came from the table 1.2, Chapter 1, Volume 2 of IPCC Guidelines for National GHG Inventories 2006.

From http://greencleanguide.com/2011/10/25/calculate-co2-emissions-from-fossil-fuel-combustion/

Calculate Methane (CH4) and Nitrous Oxide (N2O) emissions

Methane (CH4) calculation method

Run EMFAC2011-LDV to calculate CH4 for those vehicle categories;

Use CH4 = 0.0408 * TOG = 0.058821 * THC to calculate CH4 for EMFAC2011-HD categories.

Nitrous Oxide (N2O) calculation method

Use 4.16% of NOx to calculate N2O for all gasoline vehicles, the same assumption as for the emissions inventory for the Advanced Clean Cars r

Use 0.3316 g/gallon fuel to calculate for all diesel vehicles as the GHG inventory.

From: http://www.arb.ca.gov/msei/emfac2011-faq.htm#emfac2011_web_db_qstn07

Global Warming Potential

Gas	(years)	Global Warming Potential
Carbon Dioxide	50-200	1
Methane	12 ± 3	25
Nitrous Oxide	120	298
HFC-23	264	14800
HFC-134a	14.6	1430
HFC-152a	1.5	124
PFC:	50000	7390
PFC:	10000	12200
Sulfur Hexafluoride	3200	22800

May 22, 2012

Memorandum

To: Anne Whittington and Tim Leong, Port of Oakland
From: Lan Ma, Till Stoeckenius and Lit Chan
Subject: Emissions Calculation Methodology and Assumptions Used for the Oakland Army Base Area Redevelopment Plan Addendum

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1.0 Introduction

ENVIRON calculated emissions of criteria and greenhouse gas (GHG) pollutants for the 2012 Oakland Army Base (OARB) redevelopment project based on the Project Description provided to ENVIRON by the City of Oakland (City) dated 15 March 2012 and activity data provided by other Project Participants.[1] As per the Project Description and discussion with the Project Participants,[2] emissions were estimated for both the construction phase (2012 – 2019) and two years of the operations phase (2020 and 2035) of the project. ENVIRON utilized the most recent emissions estimation methodologies from the California Air Resources Board (CARB). Emissions factors for construction and industrial equipment were modeled using the OFFROAD 2011 model, and emissions factors for generator sets on refrigerated containers, or reefer gensets were modeled using the CARB's Transportation Refrigerator Unit (TRU) Calculator. Because these two emission models provide only Hydrocarbons (HC), nitrogen oxides (NOx), and particulate matter (PM) emissions, ENVIRON obtained emissions estimates for carbon monoxide (CO), sulfur oxides (SOx) and GHGs using OFFROAD 2007 as per current CARB guidance[3]. On-road vehicle emission factors were obtained from the EMFAC 2011 model.[4] Marine and rail source emissions were estimated using fleet mix characterization gathered for the Port of Oakland's maritime emissions inventory together with emission factors from applicable CARB and EPA published studies as referenced below.

2.0 Construction Emissions

Activity Data

For construction, activities for the Project Alternative "Option B1 – R&D Buildings and 7th Street Overpass" were used to estimate emissions as this combination of options would involve more total construction activity than the other project alternatives, thus producing more

[1] Project participants include the City of Oakland, the Port of Oakland, the developers (Prologis and California Capital and Investment Group) and consultants Architectural Dimensions, LSA Associates and Kittelson & Associates.
[2] Meeting held at Port of Oakland on 13 March 2012 and emails between ENVIRON and Project Participants.
[3] Personal communication with Nicole Dolney, Manager of Off-Road Diesel Analysis Section, California Air Resource Board.
[4] http://www.arb.ca.gov/jpub/webapp//EMFAC2011WebApp/emsSelectionPage_1.jsp

conservative construction emissions estimates. On-site and off-site emissions were calculated separately. On-site activity included construction equipment, vehicle movement, and barge tugs while at idle and at the berth; off-site emissions included trips generated by delivery trucks, worker commute vehicles, and barge tugs while transiting to and from the site.

Estimated hours of activity by month for each piece of construction equipment and on-road vehicles used for the duration of construction were provided to ENVIRON by Architectural Dimensions. These data, summarized by construction year, are shown in Table 1. Construction zones (Sites A – F, Rail Yard, Wharf, Maritime Street, West Burma, East Burma, 7th Street) are shown in Figure B1 of Appendix A: Air Quality and Greenhouse Gas Emissions Model Output.

Table 1. Oakland Army Base project construction activities for Project Alternative "Option 2B1 - R&D Building and 7th Street Overpass".

Vehicle Type	Fuel Type	Duration (days)	Start	Finish	Total Hours	Years of Construction (Hours)							
						2012	2013	2014	2015	2016	2017	2018	2019
Site A		**911**	**06/03/13**	**11/28/16**	**181,662**	**0**	**24,200**	**25,818**	**56,342**	**75,302**	**0**	**0**	**0**
Commuter Vehicle	UNLEADED	911	06/03/13	11/28/16	29,662	0	5,368	3,786	8,470	12,038	0	0	0
Work Truck (Ford F350)	DIESEL	911	06/03/13	11/28/16	9,936	0	1,712	1,408	2,616	4,200	0	0	0
Peterbilt WT 4000 Water Truck	DIESEL	893	06/27/13	11/28/16	4,352	0	1,216	2,136	520	480	0	0	0
Kenworth Cummings 330 Delivery Truck	DIESEL	873	06/03/13	10/05/16	65,520	0	2,160	0	26,160	37,200	0	0	0
Peterbilt 357 Concrete Truck	DIESEL	507	08/27/14	08/04/16	23,272	0	0	40	10,648	12,584	0	0	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	837	09/13/13	11/28/16	1,920	0	160	0	320	1,440	0	0	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	410	05/05/15	11/28/16	640	0	0	0	160	480	0	0	0
CAT 416D Skip (3054C DIT)	DIESEL	60	09/06/16	11/28/16	480	0	0	0	0	480	0	0	0
CAT 442E Backhoe (3054C DIT)	DIESEL	837	09/13/13	11/28/16	800	0	160	0	160	480	0	0	0
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	873	06/03/13	10/05/16	7,096	0	720	40	2,616	3,720	0	0	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	559	06/27/13	08/18/15	1,296	0	512	624	160	0	0	0	0
CAT 14H Motor Grader (C11)	DIESEL	893	06/27/13	11/28/16	1,968	0	352	776	360	480	0	0	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	503	09/13/13	08/18/15	320	0	160	0	160	0	0	0	0
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	483	06/27/13	05/04/15	1,328	0	352	776	200	0	0	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	483	06/27/13	05/04/15	1,328	0	352	776	200	0	0	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	893	06/27/13	11/28/16	10,960	0	2,112	5,808	2,560	480	0	0	0
Manitowoc 12000 Large Crane (332 hp)	DIESEL	94	06/03/13	10/10/13	720	0	720	0	0	0	0	0	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	5	09/03/14	09/09/14	40	0	0	40	0	0	0	0	0
Barge Crane	DIESEL	282	06/27/13	07/25/14	936	0	352	584	0	0	0	0	0
Building Crane	DIESEL	252	08/19/15	08/04/16	2,112	0	0	0	872	1,240	0	0	0
American 5299 Dynamic Compaction Crane	DIESEL	217	06/17/13	04/15/14	10,320	0	4,800	5,520	0	0	0	0	0
Tug (1200HP)	DIESEL	282	06/27/13	07/25/14	5,616	0	2,112	3,504	0	0	0	0	0
Air Compressor	ELECTRICAL	577	06/03/13	08/18/15	1,040	0	880	0	160	0	0	0	0
Site B		**1,089**	**06/27/13**	**08/29/17**	**176,668**	**0**	**18,128**	**13,528**	**2,596**	**62,728**	**79,688**	**0**	**0**
Commuter Vehicle	UNLEADED	1,089	06/27/13	08/29/17	20,756	0	4,296	2,312	820	5,320	8,008	0	0
Work Truck (Ford F350)	DIESEL	1,089	06/27/13	08/29/17	7,640	0	1,368	1,032	232	2,192	2,816	0	0
Peterbilt WT 4000 Water Truck	DIESEL	1,077	07/15/13	08/29/17	2,424	0	736	424	144	640	480	0	0
Kenworth Cummings 330 Delivery Truck	DIESEL	1,065	07/09/13	08/07/17	79,112	0	2,088	464	0	31,680	44,880	0	0
Peterbilt 357 Concrete Truck	DIESEL	610	02/04/15	06/06/17	33,168	0	0	0	80	16,672	16,416	0	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	969	12/12/13	08/29/17	1,920	0	88	72	0	320	1,440	0	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	322	06/06/16	08/29/17	640	0	0	0	0	160	480	0	0
CAT 416D Skip (3054C DIT)	DIESEL	60	06/07/17	08/29/17	480	0	0	0	0	0	480	0	0
CAT 442E Backhoe (3054C DIT)	DIESEL	969	12/12/13	08/29/17	800	0	88	72	0	160	480	0	0
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	1,029	08/28/13	08/07/17	4,848	0	648	72	80	1,712	2,336	0	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	779	07/09/13	07/01/16	2,672	0	1,024	1,408	80	160	0	0	0
CAT 14H Motor Grader (C11)	DIESEL	1,077	07/15/13	08/29/17	1,216	0	216	128	72	320	480	0	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	779	07/09/13	07/01/16	712	0	232	320	0	160	0	0	0
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	755	07/15/13	06/03/16	576	0	216	128	72	160	0	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	755	07/15/13	06/03/16	576	0	216	128	72	160	0	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	1,077	07/15/13	08/29/17	5,680	0	1,296	960	864	2,080	480	0	0

Vehicle Type	Fuel Type	Duration (days)	Start	Finish	Total Hours	Years of Construction (Hours)							
						2012	2013	2014	2015	2016	2017	2018	2019
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	395	08/28/13	03/03/15	800	0	648	72	80	0	0	0	0
Barge Crane	DIESEL	471	07/15/13	05/05/15	312	0	216	96	0	0	0	0	0
Building Crane	DIESEL	176	10/04/16	06/06/17	1,584	0	0	0	0	672	912	0	0
American 5299 Dynamic Compaction Crane	DIESEL	273	06/27/13	07/14/14	7,840	0	2,720	5,120	0	0	0	0	0
Tug (1200HP)	DIESEL	471	07/15/13	05/05/15	1,872	0	1,296	576	0	0	0	0	0
Air Compressor	ELECTRICAL	743	08/28/13	07/01/16	1,040	0	736	144	0	160	0	0	0
Site C		**1,056**	**07/09/13**	**07/25/17**	**165,730**	**0**	**5,658**	**26,254**	**4,266**	**67,958**	**61,594**	**0**	**0**
Commuter Vehicle	UNLEADED	1,056	07/09/13	07/25/17	21,002	0	874	5,702	810	7,398	6,218	0	0
Work Truck (Ford F350)	DIESEL	1,056	07/09/13	07/25/17	8,040	0	432	2,208	432	2,752	2,216	0	0
Peterbilt WT 4000 Water Truck	DIESEL	1,040	07/31/13	07/25/17	2,040	0	168	720	80	592	480	0	0
Kenworth Cummings 330 Delivery Truck	DIESEL	1,034	07/17/13	07/03/17	71,952	0	176	2,824	312	34,760	33,880	0	0
Peterbilt 357 Concrete Truck	DIESEL	559	03/12/15	05/02/17	28,280	0	0	0	40	15,712	12,528	0	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	851	04/22/14	07/25/17	1,920	0	0	160	0	320	1,440	0	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	300	06/01/16	07/25/17	640	0	0	0	0	160	480	0	0
CAT 416D Skip (3054C DIT)	DIESEL	60	05/03/17	07/25/17	480	0	0	0	0	0	480	0	0
CAT 442E Backhoe (3054C DIT)	DIESEL	851	04/22/14	07/25/17	800	0	0	160	0	160	480	0	0
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	905	01/14/14	07/03/17	4,712	0	0	720	40	2,216	1,736	0	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	770	07/17/13	06/28/16	6,432	0	936	3,656	1,600	240	0	0	0
CAT 14H Motor Grader (C11)	DIESEL	1,040	07/31/13	07/25/17	1,064	0	56	192	40	296	480	0	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	770	07/17/13	06/28/16	1,472	0	176	824	312	160	0	0	0
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	740	07/31/13	05/31/16	424	0	56	192	40	136	0	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	740	07/31/13	05/31/16	424	0	56	192	40	136	0	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	1,040	07/31/13	07/25/17	4,240	0	336	1,152	480	1,792	480	0	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	641	01/14/14	06/28/16	840	0	0	720	40	80	0	0	0
Barge Crane	DIESEL	459	07/31/13	05/05/15	232	0	56	176	0	0	0	0	0
Building Crane	DIESEL	176	08/30/16	05/02/17	1,584	0	0	0	0	888	696	0	0
American 5299 Dynamic Compaction Crane	DIESEL	324	07/09/13	10/03/14	6,720	0	2,000	4,720	0	0	0	0	0
Tug (1200HP)	DIESEL	459	07/31/13	05/05/15	1,392	0	336	1,056	0	0	0	0	0
Air Compressor	ELECTRICAL	641	01/14/14	06/28/16	1,040	0	0	880	0	160	0	0	0
Site D		**1,197**	**12/11/13**	**07/12/18**	**374,540**	**0**	**1,296**	**22,024**	**11,848**	**31,734**	**225,560**	**82,078**	**0**
Commuter Vehicle	UNLEADED	1,197	12/11/13	07/12/18	37,972	0	240	4,976	1,336	2,510	20,408	8,502	0
Work Truck (Ford F350)	DIESEL	1,197	12/11/13	07/12/18	14,584	0	96	3,216	1,392	1,256	5,864	2,760	0
Peterbilt WT 4000 Water Truck	DIESEL	1,085	03/07/14	05/03/18	3,064	0	0	712	1,344	528	0	480	0
Kenworth Cummings 330 Delivery Truck	DIESEL	1,162	01/29/14	07/12/18	168,360	0	0	2,376	544	16,640	105,520	43,280	0
Peterbilt 357 Concrete Truck	DIESEL	440	09/05/16	05/11/18	109,472	0	0	0	0	6,816	82,944	19,712	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	963	08/26/14	05/03/18	1,920	0	0	160	0	320	0	1,440	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	454	08/08/16	05/03/18	640	0	0	0	0	160	0	480	0
CAT 416D Skip (3054C DIT)	DIESEL	60	02/09/18	05/03/18	480	0	0	0	0	0	0	480	0
CAT 442E Backhoe (3054C DIT)	DIESEL	963	08/26/14	05/03/18	800	0	0	160	0	160	0	480	0
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	1,083	05/20/14	07/12/18	9,696	0	0	720	0	832	5,864	2,280	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	678	01/29/14	09/02/16	4,512	0	0	1,424	2,928	160	0	0	0
CAT 14H Motor Grader (C11)	DIESEL	1,085	03/07/14	05/03/18	1,184	0	0	184	256	264	0	480	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	678	01/29/14	09/02/16	1,080	0	0	376	544	160	0	0	0

Vehicle Type	Fuel Type	Duration (days)	Start	Finish	Total Hours	Years of Construction (Hours)							
						2012	2013	2014	2015	2016	2017	2018	2019
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	631	03/07/14	08/05/16	544	0	0	184	256	104	0	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	631	03/07/14	08/05/16	544	0	0	184	256	104	0	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	1,085	03/07/14	05/03/18	4,528	0	0	1,104	1,536	1,408	0	480	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	90	05/20/14	09/22/14	720	0	0	720	0	0	0	0	0
Barge Crane	DIESEL	347	03/07/14	07/06/15	392	0	0	184	208	0	0	0	0
Building Crane	DIESEL	374	12/06/16	05/11/18	6,336	0	0	0	0	152	4,960	1,224	0
American 5299 Dynamic Compaction Crane	DIESEL	258	12/11/13	12/05/14	5,040	0	960	4,080	0	0	0	0	0
Tug (1200HP)	DIESEL	347	03/07/14	07/06/15	2,352	0	0	1,104	1,248	0	0	0	0
Air Compressor	ELECTRICAL	529	08/26/14	09/02/16	320	0	0	160	0	160	0	0	0
Site E		**1,942**	**07/18/12**	**12/26/19**	**362,188**	**23,584**	**23,584**	**6,604**	**24,560**	**8,100**	**17,224**	**152,624**	**105,908**
Commuter Vehicle	UNLEADED	1,942	07/18/12	12/26/19	47,452	288	288	2,460	4,280	988	3,120	15,528	20,500
Work Truck (Ford F350)	DIESEL	1,942	07/18/12	12/26/19	15,800	256	256	592	2,232	512	1,288	5,256	5,408
Peterbilt WT 4000 Water Truck	DIESEL	1,942	07/18/12	12/26/19	3,576	512	512	16	144	696	1,216	0	480
Kenworth Cummings 330 Delivery Truck	DIESEL	1,357	09/23/14	12/04/19	143,400	0	0	1,728	1,472	280	2,000	85,120	52,800
Peterbilt 357 Concrete Truck	DIESEL	504	10/30/17	10/03/19	56,480	0	0	0	0	0	760	39,352	16,368
Kenworth Cummings 350 Dbl Bottom	DIESEL	1,942	07/18/12	12/26/19	45,440	21,760	21,760	16	144	0	320	0	1,440
CAT CS74 Roller (C6.6 ACERT)	DIESEL	564	10/30/17	12/26/19	640	0	0	0	0	0	160	0	480
CAT 416D Skip (3054C DIT)	DIESEL	60	10/04/19	12/26/19	480	0	0	0	0	0	0	0	480
CAT 442E Backhoe (3054C DIT)	DIESEL	1,303	12/30/14	12/26/19	800	0	0	16	144	0	160	0	480
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	1,357	09/23/14	12/04/19	11,264	0	0	576	144	0	360	5,256	4,928
CAT 345 CL Excavator (C13 ACERT)	DIESEL	759	12/30/14	11/24/17	7,312	0	0	16	5,344	1,632	320	0	0
CAT 14H Motor Grader (C11)	DIESEL	1,942	07/18/12	12/26/19	1,832	256	256	0	0	232	608	0	480
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	759	12/30/14	11/24/17	1,640	0	0	16	1,184	280	160	0	0
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	1,378	07/18/12	10/27/17	1,192	256	256	0	0	232	448	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	1,378	07/18/12	10/27/17	1,192	256	256	0	0	232	448	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	913	06/28/16	12/26/19	7,408	0	0	0	0	1,392	5,536	0	480
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	849	09/23/14	12/22/17	880	0	0	576	144	0	160	0	0
Barge Crane	DIESEL	29	06/28/16	08/05/16	232	0	0	0	0	232	0	0	0
Building Crane	DIESEL	440	01/26/18	10/03/19	3,696	0	0	0	0	0	0	2,112	1,584
American 5299 Dynamic Compaction Crane	DIESEL	113	01/27/15	07/02/15	9,040	0	0	0	9,040	0	0	0	0
Tug (1200HP)	DIESEL	29	06/28/16	08/05/16	1,392	0	0	0	0	1,392	0	0	0
Air Compressor	ELECTRICAL	829	09/23/14	11/24/17	1,040	0	0	592	288	0	160	0	0
Site F		**916**	**01/27/15**	**07/31/18**	**73,246**	**0**	**0**	**0**	**12,904**	**15,104**	**8,466**	**36,772**	**0**
Commuter Vehicle	UNLEADED	916	01/27/15	07/31/18	10,680	0	0	0	3,840	1,872	948	4,020	0
Work Truck (Ford F350)	DIESEL	916	01/27/15	07/31/18	4,368	0	0	0	1,144	1,056	600	1,568	0
Peterbilt WT 4000 Water Truck	DIESEL	846	05/05/15	07/31/18	2,336	0	0	0	160	1,104	592	480	0
Kenworth Cummings 330 Delivery Truck	DIESEL	900	01/27/15	07/09/18	23,088	0	0	0	2,160	688	2,160	18,080	0
Peterbilt 357 Concrete Truck	DIESEL	110	12/06/17	05/08/18	7,744	0	0	0	0	0	576	7,168	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	846	05/05/15	07/31/18	1,920	0	0	0	160	0	320	1,440	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	190	11/08/17	07/31/18	640	0	0	0	0	0	160	480	0
CAT 416D Skip (3054C DIT)	DIESEL	60	05/09/18	07/31/18	480	0	0	0	0	0	0	480	0
CAT 442E Backhoe (3054C DIT)	DIESEL	846	05/05/15	07/31/18	800	0	0	0	160	0	160	480	0
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	900	01/27/15	07/09/18	1,952	0	0	0	720	0	144	1,088	0

Vehicle Type	Fuel Type	Duration (days)	Start	Finish	Total Hours	Years of Construction (Hours)							
						2012	2013	2014	2015	2016	2017	2018	2019
CAT 345 CL Excavator (C13 ACERT)	DIESEL	676	05/05/15	12/05/17	4,128	0	0	0	160	3,808	160	0	0
CAT 14H Motor Grader (C11)	DIESEL	517	08/08/16	07/31/18	1,144	0	0	0	0	368	296	480	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	676	05/05/15	12/05/17	1,008	0	0	0	160	688	160	0	0
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	327	08/08/16	11/07/17	504	0	0	0	0	368	136	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	327	08/08/16	11/07/17	470	0	0	0	0	368	102	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	517	08/08/16	07/31/18	4,480	0	0	0	0	2,208	1,792	480	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	90	01/27/15	06/01/15	720	0	0	0	720	0	0	0	0
Barge Crane	DIESEL	46	08/08/16	10/10/16	368	0	0	0	0	368	0	0	0
Building Crane	DIESEL	66	02/06/18	05/08/18	528	0	0	0	0	0	0	528	0
American 5299 Dynamic Compaction Crane	DIESEL	33	07/03/15	08/18/15	2,640	0	0	0	2,640	0	0	0	0
Tug (1200HP)	DIESEL	46	08/08/16	10/10/16	2,208	0	0	0	0	2,208	0	0	0
Air Compressor	ELECTRICAL	746	01/27/15	12/05/17	1,040	0	0	0	880	0	160	0	0
Rail Yard		**504**	**03/26/15**	**02/28/17**	**41,642**	**0**	**0**	**0**	**20,718**	**17,765**	**3,158**	**0**	**0**
Commuter Vehicle	UNLEADED	504	03/26/15	02/28/17	4,247	0	0	0	1,673	2,088	486	0	0
Work Truck (Ford F350)	DIESEL	379	06/11/15	11/22/16	10,612	0	0	0	3,622	6,991	0	0	0
Peterbilt WT 4000 Water Truck	DIESEL	494	03/26/15	02/14/17	880	0	0	0	720	0	160	0	0
Kenworth Cummings 330 Delivery Truck	DIESEL	449	06/11/15	02/28/17	1,320	0	0	0	920	0	400	0	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	484	03/26/15	01/31/17	6,720	0	0	0	5,920	0	800	0	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	20	01/18/17	02/14/17	240	0	0	0	0	0	240	0	0
Delmag 30/32 Pile Hammer	DIESEL	20	06/11/15	07/08/15	160	0	0	0	160	0	0	0	0
CAT 416D Skip (3054C DIT)	DIESEL	20	01/18/17	02/14/17	160	0	0	0	0	0	160	0	0
CAT 442E Backhoe (3054C DIT)	DIESEL	20	03/26/15	04/22/15	160	0	0	0	160	0	0	0	0
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	429	06/11/15	01/31/17	3,811	0	0	0	2,219	1,419	176	0	0
CAT 320D Excavator (C6.4 ACERT)	DIESEL	189	09/25/15	06/15/16	1,895	0	0	0	703	1,195	0	0	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	55	03/26/15	06/10/15	440	0	0	0	440	0	0	0	0
CAT AP-1055B Paver (C7)	DIESEL	10	02/01/17	02/14/17	80	0	0	0	0	0	80	0	0
CAT 14H Motor Grader (C11)	DIESEL	464	04/23/15	01/31/17	360	0	0	0	280	0	80	0	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	504	03/26/15	02/28/17	3,133	0	0	0	1,781	1,195	160	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	35	04/23/15	06/10/15	280	0	0	0	280	0	0	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	464	04/23/15	01/31/17	360	0	0	0	280	0	80	0	0
Manitowoc 12000 Large Crane (332 hp)	DIESEL	449	06/11/15	02/28/17	320	0	0	0	160	0	160	0	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	50	11/23/16	01/31/17	400	0	0	0	0	224	176	0	0
Ballast Regulator	DIESEL	114	06/16/16	11/22/16	1,137	0	0	0	0	1,136	0	0	0
Mark II Ballast Tamper	DIESEL	114	06/16/16	11/22/16	1,137	0	0	0	0	1,136	0	0	0
Rail Car	Null	379	06/11/15	11/22/16	0	0	0	0	0	0	0	0	0
Rail Saw and Drill	ELECTRICAL	189	09/25/15	06/15/16	1,895	0	0	0	703	1,195	0	0	0
Air Compressor	ELECTRICAL	189	09/25/15	06/15/16	1,895	0	0	0	703	1,195	0	0	0
Wharf		**500**	**06/02/15**	**05/01/17**	**71,700**	**0**	**0**	**0**	**14,303**	**49,829**	**7,568**	**0**	**0**
Commuter Vehicle	UNLEADED	500	06/02/15	05/01/17	6,900	0	0	0	1,495	4,717	688	0	0
Work Truck (Ford F350)	DIESEL	500	06/02/15	05/01/17	7,200	0	0	0	1,648	4,864	688	0	0
Kenworth Cummings 330 Delivery Truck	DIESEL	500	06/02/15	05/01/17	19,200	0	0	0	3,720	13,416	2,064	0	0
Peterbilt 357 Concrete Truck	DIESEL	400	10/20/15	05/01/17	14,400	0	0	0	1,272	11,064	2,064	0	0
Delmag 30/32 Pile Hammer	DIESEL	300	06/02/15	07/25/16	2,400	0	0	0	1,224	1,176	0	0	0

Vehicle Type	Fuel Type	Duration (days)	Start	Finish	Total Hours	Years of Construction (Hours)							
						2012	2013	2014	2015	2016	2017	2018	2019
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	400	10/20/15	05/01/17	4,800	0	0	0	424	3,688	688	0	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	300	06/02/15	07/25/16	2,400	0	0	0	1,224	1,176	0	0	0
Manitowoc 12000 Large Crane (332 hp)	DIESEL	300	06/02/15	07/25/16	2,400	0	0	0	1,224	1,176	0	0	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	400	10/20/15	05/01/17	4,800	0	0	0	424	3,688	688	0	0
Air Compressor	ELECTRICAL	500	06/02/15	05/01/17	7,200	0	0	0	1,648	4,864	688	0	0
Maritime Street		**288**	**09/12/14**	**10/20/15**	**20,030**	**0**	**0**	**5,279**	**14,751**	**0**	**0**	**0**	**0**
Commuter Vehicle	UNLEADED	288	09/12/14	10/20/15	2,318	0	0	639	1,679	0	0	0	0
Work Truck (Ford F350)	DIESEL	288	09/12/14	10/20/15	2,264	0	0	632	1,632	0	0	0	0
Peterbilt WT 4000 Water Truck	DIESEL	248	10/10/14	09/22/15	1,584	0	0	472	1,112	0	0	0	0
Kenworth Cummings 330 Delivery Truck	DIESEL	174	09/12/14	05/13/15	600	0	0	400	200	0	0	0	0
Peterbilt 357 Concrete Truck	DIESEL	129	03/20/15	09/16/15	960	0	0	0	960	0	0	0	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	258	09/26/14	09/22/15	4,720	0	0	880	3,840	0	0	0	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	193	12/26/14	09/22/15	496	0	0	32	464	0	0	0	0
CAT 416D Skip (3054C DIT)	DIESEL	143	03/06/15	09/22/15	584	0	0	0	584	0	0	0	0
CAT 442E Backhoe (3054C DIT)	DIESEL	253	10/31/14	10/20/15	960	0	0	320	640	0	0	0	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	224	09/26/14	08/05/15	1,120	0	0	480	640	0	0	0	0
CAT AP-1055B Paver (C7)	DIESEL	103	05/01/15	09/22/15	184	0	0	0	184	0	0	0	0
CAT 14H Motor Grader (C11)	DIESEL	224	10/10/14	08/19/15	520	0	0	152	368	0	0	0	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	179	10/31/14	07/08/15	720	0	0	320	400	0	0	0	0
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	179	09/26/14	06/03/15	160	0	0	80	80	0	0	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	184	10/10/14	06/24/15	240	0	0	120	120	0	0	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	224	10/10/14	08/19/15	880	0	0	272	608	0	0	0	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	288	09/12/14	10/20/15	280	0	0	80	200	0	0	0	0
Air Compressor	ELECTRICAL	278	09/26/14	10/20/15	1,440	0	0	400	1,040	0	0	0	0
West Burma		**288**	**11/08/17**	**12/14/18**	**19,422**	**0**	**0**	**0**	**0**	**0**	**2,197**	**17,225**	**0**
Commuter Vehicle	UNLEADED	288	11/08/17	12/14/18	2,378	0	0	0	0	0	245	2,133	0
Work Truck (Ford F350)	DIESEL	278	11/22/17	12/14/18	2,224	0	0	0	0	0	224	2,000	0
Peterbilt WT 4000 Water Truck	DIESEL	258	11/22/17	11/16/18	1,664	0	0	0	0	0	224	1,440	0
Kenworth Cummings 330 Delivery Truck	DIESEL	179	11/08/17	07/16/18	640	0	0	0	0	0	240	400	0
Peterbilt 357 Concrete Truck	DIESEL	129	05/16/18	11/12/18	960	0	0	0	0	0	0	960	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	258	11/22/17	11/16/18	3,780	0	0	0	0	0	288	3,492	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	193	02/21/18	11/16/18	448	0	0	0	0	0	0	448	0
CAT 416D Skip (3054C DIT)	DIESEL	143	05/02/18	11/16/18	544	0	0	0	0	0	0	544	0
CAT 442E Backhoe (3054C DIT)	DIESEL	253	12/27/17	12/14/18	1,040	0	0	0	0	0	24	1,016	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	224	11/22/17	10/01/18	1,200	0	0	0	0	0	184	1,016	0
CAT AP-1055B Paver (C7)	DIESEL	103	06/27/18	11/16/18	64	0	0	0	0	0	0	64	0
CAT 14H Motor Grader (C11)	DIESEL	224	12/06/17	10/15/18	560	0	0	0	0	0	120	440	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	199	12/27/17	10/01/18	880	0	0	0	0	0	24	856	0
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	179	11/22/17	07/30/18	160	0	0	0	0	0	80	80	0
CAT 815F Compactor (9 ACERT)	DIESEL	184	12/06/17	08/20/18	240	0	0	0	0	0	120	120	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	224	12/06/17	10/15/18	800	0	0	0	0	0	240	560	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	288	11/08/17	12/14/18	320	0	0	0	0	0	80	240	0
Air Compressor	ELECTRICAL	278	11/22/17	12/14/18	1,520	0	0	0	0	0	104	1,416	0

Vehicle Type	Fuel Type	Duration (days)	Start	Finish	Total Hours	Years of Construction (Hours)							
						2012	2013	2014	2015	2016	2017	2018	2019
East Burma		**79**	**06/01/16**	**09/19/16**	**5,831**	**0**	**0**	**0**	**0**	**5,831**	**0**	**0**	**0**
Commuter Vehicle	UNLEADED	79	06/01/16	09/19/16	679	0	0	0	0	679	0	0	0
Work Truck (Ford F350)	DIESEL	79	06/01/16	09/19/16	632	0	0	0	0	632	0	0	0
Peterbilt WT 4000 Water Truck	DIESEL	79	06/01/16	09/19/16	472	0	0	0	0	472	0	0	0
Peterbilt 357 Concrete Truck	DIESEL	20	08/17/16	09/13/16	480	0	0	0	0	480	0	0	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	64	06/22/16	09/19/16	1,440	0	0	0	0	1,440	0	0	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	54	07/06/16	09/19/16	224	0	0	0	0	224	0	0	0
CAT 416D Skip (3054C DIT)	DIESEL	34	08/03/16	09/19/16	272	0	0	0	0	272	0	0	0
CAT 442E Backhoe (3054C DIT)	DIESEL	30	06/22/16	08/02/16	160	0	0	0	0	160	0	0	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	30	06/22/16	08/02/16	160	0	0	0	0	160	0	0	0
CAT AP-1055B Paver (C7)	DIESEL	4	09/14/16	09/19/16	32	0	0	0	0	32	0	0	0
CAT 14H Motor Grader (C11)	DIESEL	55	06/01/16	08/16/16	280	0	0	0	0	280	0	0	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	30	06/22/16	08/02/16	160	0	0	0	0	160	0	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	15	06/01/16	06/21/16	120	0	0	0	0	120	0	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	55	06/01/16	08/16/16	400	0	0	0	0	400	0	0	0
Air Compressor	ELECTRICAL	60	06/22/16	09/13/16	320	0	0	0	0	320	0	0	0
7th Street Reconstruction		**507**	**02/17/14**	**01/26/16**	**126,525**	**0**	**0**	**74,387**	**51,128**	**1,010**	**0**	**0**	**0**
Commuter Vehicle	UNLEADED	507	02/17/14	01/26/16	13,941	0	0	8,283	5,528	130	0	0	0
Work Truck (Ford F350)	DIESEL	507	02/17/14	01/26/16	12,936	0	0	7,128	5,664	144	0	0	0
Peterbilt WT 4000 Water Truck	DIESEL	482	02/17/14	12/22/15	3,208	0	0	1,640	1,568	0	0	0	0
Kenworth Cummings 330 Delivery Truck	DIESEL	507	02/17/14	01/26/16	24,344	0	0	14,280	9,472	592	0	0	0
Peterbilt 357 Concrete Truck	DIESEL	467	03/03/14	12/15/15	20,160	0	0	11,896	8,264	0	0	0	0
Kenworth Cummings 350 Dbl Bottom	DIESEL	482	02/17/14	12/22/15	11,520	0	0	7,840	3,680	0	0	0	0
CAT CS74 Roller (C6.6 ACERT)	DIESEL	228	09/10/14	07/24/15	336	0	0	72	264	0	0	0	0
Delmag 30/32 Pile Hammer	DIESEL	318	05/05/14	07/22/15	840	0	0	760	80	0	0	0	0
CAT 416D Skip (3054C DIT)	DIESEL	355	07/02/14	11/10/15	448	0	0	16	432	0	0	0	0
CAT 442E Backhoe (3054C DIT)	DIESEL	447	04/14/14	12/29/15	2,560	0	0	400	2,160	0	0	0	0
CAT TL 1055 Forklift (C4.4 EIDITAAC)	DIESEL	477	02/17/14	12/15/15	7,912	0	0	5,272	2,640	0	0	0	0
CAT 345 CL Excavator (C13 ACERT)	DIESEL	333	03/31/14	07/08/15	2,024	0	0	1,208	816	0	0	0	0
CAT AP-1055B Paver (C7)	DIESEL	4	06/15/15	06/18/15	32	0	0	0	32	0	0	0	0
CAT 14H Motor Grader (C11)	DIESEL	375	02/17/14	07/24/15	768	0	0	448	320	0	0	0	0
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	373	02/17/14	07/22/15	2,200	0	0	1,560	640	0	0	0	0
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	333	03/31/14	07/08/15	864	0	0	608	256	0	0	0	0
CAT 815F Compactor (9 ACERT)	DIESEL	363	02/17/14	07/08/15	1,000	0	0	784	216	0	0	0	0
CAT 627G Scraper (CAT C15/CAT C9 ACERT)	DIESEL	278	07/02/14	07/24/15	528	0	0	88	440	0	0	0	0
Manitowoc 12000 Large Crane (332 hp)	DIESEL	432	03/03/14	10/27/15	1,856	0	0	1,456	400	0	0	0	0
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	507	02/17/14	01/26/16	8,096	0	0	4,416	3,536	144	0	0	0
Air Compressor	ELECTRICAL	477	03/03/14	12/29/15	10,952	0	0	6,232	4,720	0	0	0	0
Total Construction		**1,942**	**07/18/12**	**12/26/19**	**1,619,184**	**23,584**	**72,866**	**173,894**	**213,416**	**335,361**	**405,455**	**288,699**	**105,908**

Architectural Dimension also provided estimates of the fraction of time each piece of equipment would be used on-site and off-site (see Table 2). For off-road construction equipment, on-site idling and on-site operation were not modeled separately as time spent idling has already been assumed to be included in the average engine load factors used in the emissions calculation. For on-road vehicle sources, idling emissions were calculated separately, and an average on-site travel speed of 15 mph was assumed. As estimated by Architectural Dimension, off-site travel for on-road vehicle sources was assumed to occur at an average speed of 40 mph.

Table 2. On-site and off-site trip fractions for construction vehicles.

Resource Name	Fuel Type	Off Site Hours	On-Site Hours	On-Site Idle
OAB Vehicles				
Commuter Vehicle	UNLEADED	95%	5%	0%
Trucking				
Work Truck (Ford F350)	DIESEL	0%	85%	15%
Peterbilt WT 4000 Water Truck	DIESEL	0%	85%	15%
Kenworth Cummings 330 Delivery Truck	DIESEL	0%	85%	15%
Peterbilt 357 Concrete Truck	DIESEL	70%	10%	20%
Kenworth Cummings 350 Dbl Bottom	DIESEL	0%	85%	15%
Equipment				
CAT CS74 Roller (C6.6 ACERT)	DIESEL	0%	85%	15%
Delmag 30/32 Pile Hammer	DIESEL	0%	85%	15%
CAT 416D Skip (3054C DIT)	DIESEL	0%	85%	15%
CAT 442E Backhoe (3054C)	DIESEL	0%	85%	15%
CAT TL 1055 Folklift (C4.4 EIDITAAC)	DIESEL	0%	90%	10%
Heavy Equipment				
CAT 320D Excavator (C6.4 ACERT)	DIESEL	0%	90%	10%
CAT345 CL Excavator (C13 ACERT)	DIESEL	0%	90%	10%
CAT AP-1055B Paver (C7)	DIESEL	0%	90%	10%
CAT 14H Motor Grader (C11)	DIESEL	0%	90%	10%
CAT 966 Large Rubber Tire Loader (C7 ATAAC)	DIESEL	0%	90%	10%
CAT D8R Bull Dozer (3406C SCAC)	DIESEL	0%	90%	10%
CAT 815F Compactors (9 ACERT)	DIESEL	0%	90%	10%
CAT 627G Scrapers (CAT C15/CAT C9 ACERT)	DIESEL	0%	90%	10%
Crane				
Manitowoc 12000 Large Crane (332 hp)	DIESEL	0%	75%	25%
TEREX RT 555 Small Crane (Cummings QSB 185)	DIESEL	0%	75%	25%
Barge Crane	DIESEL	0%	75%	25%
Building Crane	DIESEL	0%	75%	25%
American 5299 Dynamic Compaction Crane	DIESEL	0%	75%	25%
Barge Tug				
Tug (2 x 855 hp)	DIESEL	80%	0%	20%
Rail Tools				
Ballast Regulator	DIESEL	0%	100%	0%
Mark II Ballast Tamper	DIESEL	0%	100%	0%
Rail Car	Null	0%	100%	0%
Small Tools				
Rail Saw and Drill	ELECTRICAL	0%	100%	0%
Air Compressor	ELECTRICAL	0%	100%	0%

Tugs used to move barges that would bring fill to the project site from Decker Island in the San Francisco Bay Delta were specified to be model year 2003 Cat 3508B tugs with two engines at 855 horsepower each. Two tugs would be needed for each complete roundtrip – one to bring the barge to the construction site from Decker Island and one to take the barge back out. Given the logistical considerations, a total of six tugs would be needed to complete the required three barge deliveries per day. Each one-way trip was assumed to be composed of six hours of transit and two hours of idling on-site.

Emission Factors

HC, NOx and PM emission factors for all construction equipment were modeled using the CARB's latest 2011 inventory model for in-use off-road equipment ("OFFROAD2011").[5] Because OFFROAD2011 only generates emission factors for these three pollutants, the CARB OFFROAD2007 model was used to calculate emission factors for CO, SOx, and the three greenhouse gases analyzed: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Load factors were generally obtained from OFFROAD2011 for each piece of equipment. Horsepower information was either provided by Architectural Dimension or manufacturer specification sheets that ENVIRON has obtained. A few pieces of equipment lack detailed descriptions and ENVIRON has used default horsepower information from the OFFROAD2011 model; these included cranes, pile hammers, ballast tampers, and rail saw and drills. Emission factors for on-road vehicles were obtained from CARB's EMFAC2011 model. In addition to all the pollutants mentioned above, PM emissions from tire wear and brake wear were modeled for all on-road vehicle sources, and evaporative running loss hydrocarbon emissions were also modeled for gasoline-fueled employee commute vehicles. Note that road dust and fugitive dust emissions were not evaluated in this study due to lack of available data and conformance with Bay Area Air Quality Management District (BAAQMD) May 2011 California Environmental Quality Act Guidance[6] which only recommends evaluation of exhaust emissions. ENVIRON researched the trucks used for construction, and classified all trucks except the Ford F350 as heavy-heavy duty diesel trucks. The Ford F350 work truck was modeled as a light-heavy duty diesel truck. All employee commute vehicles were assumed to be light-duty, gasoline-fueled automobiles. Emission factors were based on an assumed on-site travel speed of 15 mph and an off-site travel speed of 40 mph. Emission factors for barge tugs were calculated using the methodologies specified for tugs in CARB's emission regulation for harbor crafts operating in California. [7]

Due to equipment turnover, deterioration, and regulation mandates, emissions factors vary from year to year. Table 3 and Table 4 below summarize the emissions factors used for the construction phase for off-road sources (construction equipment and barge tugs) and on-road sources (vehicles), respectively.

[5] http://www.arb.ca.gov/msei/off-road-emissions-inventory-v3-scenpop-and-hp.mdb

[6] http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/BAAQMD%20CEQA%20Guidelines%20May%202011.ashx?la=en

[7] http://www.arb.ca.gov/ports/marinevess/harborcraft.htm

Table 3. Emissions factors for project construction related off-road sources.

Year	Equipment	Fuel	HP	LF	Emission Factors (g/hp-hr)									
					TOG	ROG	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	N2O
2012	Tug (1200HP) Idle	Diesel	1710	0.1	0.920	0.808	2.181	7.554	0.006	0.371	0.360	568.030	0.073	0.020
2012	Tug (1200HP) Maneuver	Diesel	1710	0.1	0.920	0.808	2.181	7.554	0.006	0.371	0.360	568.030	0.073	0.020
2012	Tug (1200HP) Transit	Diesel	1710	0.5	0.920	0.808	2.181	7.554	0.006	0.371	0.360	568.030	0.073	0.020
2012	Air Compressor	Electrical	78	0.3216	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	American 5299 Dynamic Compaction Crane	Diesel	208	0.2881	0.612	0.512	2.359	8.302	0.010	0.381	0.350	852.450	0.076	0.000
2012	Ballast Regulator	Diesel	240	0.3417	0.502	0.420	2.022	7.144	0.010	0.308	0.284	852.450	0.067	0.000
2012	Barge Crane	Diesel	208	0.2881	0.612	0.512	2.359	8.302	0.010	0.381	0.350	852.450	0.076	0.000
2012	Building Crane	Diesel	208	0.2881	0.612	0.512	2.359	8.302	0.010	0.381	0.350	852.450	0.076	0.000
2012	CAT 14H Motor Grader (C11)	Diesel	240	0.4087	0.334	0.279	2.233	5.777	0.010	0.185	0.171	852.450	0.070	0.000
2012	CAT 320D Excavator (C6.4 ACERT)	Diesel	148	0.3819	0.397	0.332	5.072	5.389	0.010	0.275	0.253	852.450	0.088	0.000
2012	CAT 416D Skip (3054C DIT)	Diesel	77	0.3685	0.569	0.476	5.861	6.079	0.010	0.490	0.450	852.450	0.113	0.000
2012	CAT 442E Backhoe (3054C DIT)	Diesel	78	0.3685	0.569	0.476	5.861	6.079	0.010	0.490	0.450	852.450	0.113	0.000
2012	CAT 627G Scraper (CAT C15/CAT C9 ACERT)	Diesel	394	0.4824	0.443	0.371	3.450	6.643	0.008	0.269	0.247	852.450	0.080	0.000
2012	CAT 815F Compactor (9 ACERT)	Diesel	253	0.3752	0.449	0.376	2.628	6.667	0.008	0.278	0.256	852.450	0.062	0.000
2012	CAT 966 Large Rubber Tire Loader (C7 ATAAC)	Diesel	216	0.3618	0.366	0.306	2.196	5.858	0.010	0.198	0.182	852.450	0.069	0.000
2012	CAT AP-1055B Paver (C7)	Diesel	174	0.4154	0.504	0.421	5.205	6.442	0.010	0.329	0.303	852.450	0.112	0.000
2012	CAT CS74 Roller (C6.6 ACERT)	Diesel	143	0.3752	0.370	0.309	4.903	5.383	0.010	0.255	0.235	852.450	0.094	0.000
2012	CAT D8R Bull Dozer (3406C SCAC)	Diesel	328	0.3953	0.656	0.549	4.903	8.584	0.008	0.401	0.369	852.450	0.097	0.000
2012	CAT TL 1055 Forklift (C4.4 EIDITAAC)	Diesel	125	0.201	0.568	0.476	5.001	7.120	0.010	0.387	0.356	852.450	0.083	0.000
2012	CAT 345 CL Excavator (C13 ACERT)	Diesel	321	0.3819	0.229	0.192	2.004	4.057	0.008	0.131	0.121	852.450	0.059	0.000
2012	Delmag 30/32 Pile Hammer	Diesel	81	0.3417	0.749	0.627	5.609	7.215	0.010	0.612	0.563	852.450	0.120	0.000
2012	Manitowoc 12000 Large Crane (332 hp)	Diesel	332	0.2881	0.455	0.381	2.695	6.789	0.008	0.281	0.259	852.450	0.070	0.000
2012	Mark II Ballast Tamper	Diesel	327	0.3417	0.354	0.296	2.120	5.398	0.008	0.207	0.190	852.450	0.062	0.000
2012	Rail Saw and Drill	Electrical	81	0.3417	0.749	0.627	5.609	7.215	0.010	0.612	0.563	852.450	0.120	0.000
2012	TEREX RT 555 Small Crane (Cummings QSB 185)	Diesel	208	0.2881	0.612	0.512	2.359	8.302	0.010	0.381	0.350	852.450	0.076	0.000
2013	Tug (1200HP) Idle	Diesel	1710	0.1	0.936	0.822	2.205	7.623	0.006	0.380	0.368	568.030	0.074	0.020
2013	Tug (1200HP) Maneuver	Diesel	1710	0.1	0.936	0.822	2.205	7.623	0.006	0.380	0.368	568.030	0.074	0.020
2013	Tug (1200HP) Transit	Diesel	1710	0.5	0.936	0.822	2.205	7.623	0.006	0.380	0.368	568.030	0.074	0.020
2013	Air Compressor	Electrical	78	0.3216	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2013	American 5299 Dynamic Compaction Crane	Diesel	208	0.2881	0.604	0.506	2.241	8.156	0.010	0.375	0.345	852.450	0.071	0.000
2013	Ballast Regulator	Diesel	240	0.3417	0.453	0.379	1.959	6.520	0.010	0.273	0.251	852.450	0.064	0.000
2013	Barge Crane	Diesel	208	0.2881	0.604	0.506	2.241	8.156	0.010	0.375	0.345	852.450	0.071	0.000
2013	Building Crane	Diesel	208	0.2881	0.604	0.506	2.241	8.156	0.010	0.375	0.345	852.450	0.071	0.000
2013	CAT 14H Motor Grader (C11)	Diesel	240	0.4087	0.339	0.283	2.146	5.746	0.010	0.185	0.170	852.450	0.067	0.000
2013	CAT 320D Excavator (C6.4 ACERT)	Diesel	148	0.3819	0.374	0.313	5.065	5.090	0.010	0.253	0.233	852.450	0.083	0.000
2013	CAT 416D Skip (3054C DIT)	Diesel	77	0.3685	0.548	0.458	5.814	5.882	0.010	0.468	0.431	852.450	0.103	0.000
2013	CAT 442E Backhoe (3054C DIT)	Diesel	78	0.3685	0.548	0.458	5.814	5.882	0.010	0.468	0.431	852.450	0.103	0.000
2013	CAT 627G Scraper (CAT C15/CAT C9 ACERT)	Diesel	394	0.4824	0.439	0.367	3.214	6.517	0.008	0.264	0.242	852.450	0.076	0.000
2013	CAT 815F Compactor (9 ACERT)	Diesel	253	0.3752	0.349	0.292	2.457	5.437	0.008	0.213	0.196	852.450	0.058	0.000
2013	CAT 966 Large Rubber Tire Loader (C7 ATAAC)	Diesel	216	0.3618	0.369	0.309	2.109	5.753	0.010	0.196	0.181	852.450	0.065	0.000
2013	CAT AP-1055B Paver (C7)	Diesel	174	0.4154	0.468	0.392	5.172	6.059	0.010	0.304	0.280	852.450	0.106	0.000

Year	Equipment	Fuel	HP	LF	Emission Factors (g/hp-hr)									
					TOG	ROG	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	N2O
2013	CAT CS74 Roller (C6.6 ACERT)	Diesel	143	0.3752	0.348	0.291	4.886	5.113	0.010	0.238	0.219	852.450	0.089	0.000
2013	CAT D8R Bull Dozer (3406C SCAC)	Diesel	328	0.3953	0.642	0.537	4.583	8.337	0.008	0.390	0.359	852.450	0.093	0.000
2013	CAT TL 1055 Forklift (C4.4 EIDITAAC)	Diesel	125	0.201	0.553	0.462	5.006	6.902	0.010	0.375	0.345	852.450	0.076	0.000
2013	CAT 345 CL Excavator (C13 ACERT)	Diesel	321	0.3819	0.220	0.184	1.923	3.735	0.008	0.121	0.111	852.450	0.057	0.000
2013	Delmag 30/32 Pile Hammer	Diesel	81	0.3417	0.730	0.611	5.559	7.033	0.010	0.597	0.549	852.450	0.110	0.000
2013	Manitowoc 12000 Large Crane (332 hp)	Diesel	332	0.2881	0.441	0.369	2.506	6.516	0.008	0.270	0.248	852.450	0.066	0.000
2013	Mark II Ballast Tamper	Diesel	327	0.3417	0.323	0.270	2.001	4.821	0.008	0.183	0.168	852.450	0.059	0.000
2013	Rail Saw and Drill	Electrical	81	0.3417	0.730	0.611	5.559	7.033	0.010	0.597	0.549	852.450	0.110	0.000
2013	TEREX RT 555 Small Crane (Cummings QSB 185)	Diesel	208	0.2881	0.604	0.506	2.241	8.156	0.010	0.375	0.345	852.450	0.071	0.000
2014	Tug (1200HP) Idle	Diesel	1710	0.1	0.953	0.837	2.228	7.692	0.006	0.389	0.377	568.030	0.075	0.020
2014	Tug (1200HP) Maneuver	Diesel	1710	0.1	0.953	0.837	2.228	7.692	0.006	0.389	0.377	568.030	0.075	0.020
2014	Tug (1200HP) Transit	Diesel	1710	0.5	0.953	0.837	2.228	7.692	0.006	0.389	0.377	568.030	0.075	0.020
2014	Air Compressor	Electrical	78	0.3216	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	American 5299 Dynamic Compaction Crane	Diesel	208	0.2881	0.584	0.489	2.141	7.860	0.010	0.360	0.331	852.450	0.067	0.000
2014	Ballast Regulator	Diesel	240	0.3417	0.431	0.361	1.907	6.153	0.010	0.255	0.234	852.450	0.060	0.000
2014	Barge Crane	Diesel	208	0.2881	0.584	0.489	2.141	7.860	0.010	0.360	0.331	852.450	0.067	0.000
2014	Building Crane	Diesel	208	0.2881	0.584	0.489	2.141	7.860	0.010	0.360	0.331	852.450	0.067	0.000
2014	CAT 14H Motor Grader (C11)	Diesel	240	0.4087	0.345	0.288	2.069	5.740	0.010	0.185	0.171	852.451	0.063	0.000
2014	CAT 320D Excavator (C6.4 ACERT)	Diesel	148	0.3819	0.345	0.289	5.059	4.657	0.010	0.229	0.211	852.450	0.078	0.000
2014	CAT 416D Skip (3054C DIT)	Diesel	77	0.3685	0.515	0.431	5.772	5.581	0.010	0.438	0.403	852.450	0.094	0.000
2014	CAT 442E Backhoe (3054C DIT)	Diesel	78	0.3685	0.515	0.431	5.772	5.581	0.010	0.438	0.403	852.450	0.094	0.000
2014	CAT 627G Scraper (CAT C15/CAT C9 ACERT)	Diesel	394	0.4824	0.423	0.354	3.013	6.233	0.008	0.251	0.231	852.450	0.073	0.000
2014	CAT 815F Compactor (9 ACERT)	Diesel	253	0.3752	0.334	0.280	2.306	5.183	0.008	0.202	0.185	852.450	0.055	0.000
2014	CAT 966 Large Rubber Tire Loader (C7 ATAAC)	Diesel	216	0.3618	0.360	0.301	2.033	5.495	0.010	0.187	0.172	852.450	0.061	0.000
2014	CAT AP-1055B Paver (C7)	Diesel	174	0.4154	0.444	0.372	5.145	5.736	0.010	0.287	0.264	852.450	0.102	0.000
2014	CAT CS74 Roller (C6.6 ACERT)	Diesel	143	0.3752	0.325	0.272	4.872	4.724	0.010	0.219	0.202	852.450	0.084	0.000
2014	CAT D8R Bull Dozer (3406C SCAC)	Diesel	328	0.3953	0.625	0.523	4.286	8.058	0.008	0.376	0.346	852.450	0.089	0.000
2014	CAT TL 1055 Forklift (C4.4 EIDITAAC)	Diesel	125	0.201	0.511	0.428	5.012	6.352	0.010	0.345	0.317	852.450	0.069	0.000
2014	CAT 345 CL Excavator (C13 ACERT)	Diesel	321	0.3819	0.206	0.172	1.861	3.353	0.008	0.108	0.099	852.450	0.055	0.000
2014	Delmag 30/32 Pile Hammer	Diesel	81	0.3417	0.697	0.584	5.513	6.723	0.010	0.574	0.528	852.450	0.101	0.000
2014	Manitowoc 12000 Large Crane (332 hp)	Diesel	332	0.2881	0.427	0.357	2.343	6.264	0.008	0.260	0.239	852.450	0.063	0.000
2014	Mark II Ballast Tamper	Diesel	327	0.3417	0.314	0.263	1.905	4.565	0.008	0.172	0.159	852.450	0.056	0.000
2014	Rail Saw and Drill	Electrical	81	0.3417	0.697	0.584	5.513	6.723	0.010	0.574	0.528	852.450	0.101	0.000
2014	TEREX RT 555 Small Crane (Cummings QSB 185)	Diesel	208	0.2881	0.584	0.489	2.141	7.860	0.010	0.360	0.331	852.450	0.067	0.000
2015	Tug (1200HP) Idle	Diesel	1710	0.1	0.969	0.851	2.251	7.761	0.006	0.398	0.386	568.030	0.077	0.020
2015	Tug (1200HP) Maneuver	Diesel	1710	0.1	0.969	0.851	2.251	7.761	0.006	0.398	0.386	568.030	0.077	0.020
2015	Tug (1200HP) Transit	Diesel	1710	0.5	0.969	0.851	2.251	7.761	0.006	0.398	0.386	568.030	0.077	0.020
2015	Air Compressor	Electrical	78	0.3216	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	American 5299 Dynamic Compaction Crane	Diesel	208	0.2881	0.568	0.475	2.062	7.622	0.010	0.348	0.320	852.450	0.063	0.000
2015	Ballast Regulator	Diesel	240	0.3417	0.400	0.335	1.864	5.643	0.010	0.230	0.211	852.450	0.057	0.000
2015	Barge Crane	Diesel	208	0.2881	0.568	0.475	2.062	7.622	0.010	0.348	0.320	852.450	0.063	0.000
2015	Building Crane	Diesel	208	0.2881	0.568	0.475	2.062	7.622	0.010	0.348	0.320	852.450	0.063	0.000
2015	CAT 14H Motor Grader (C11)	Diesel	240	0.4087	0.350	0.293	2.004	5.728	0.010	0.186	0.171	852.449	0.059	0.000

Year	Equipment	Fuel	HP	LF	Emission Factors (g/hp-hr)									
					TOG	ROG	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	N2O
2015	CAT 320D Excavator (C6.4 ACERT)	Diesel	148	0.3819	0.339	0.284	5.054	4.481	0.010	0.221	0.203	852.450	0.072	0.000
2015	CAT 416D Skip (3054C DIT)	Diesel	77	0.3685	0.503	0.421	5.734	5.422	0.010	0.424	0.390	852.450	0.086	0.000
2015	CAT 442E Backhoe (3054C DIT)	Diesel	78	0.3685	0.503	0.421	5.734	5.422	0.010	0.424	0.390	852.450	0.086	0.000
2015	CAT 627G Scraper (CAT C15/CAT C9 ACERT)	Diesel	394	0.4824	0.418	0.349	2.836	6.086	0.008	0.246	0.226	852.450	0.069	0.000
2015	CAT 815F Compactor (9 ACERT)	Diesel	253	0.3752	0.328	0.274	2.177	5.031	0.008	0.195	0.179	852.450	0.052	0.000
2015	CAT 966 Large Rubber Tire Loader (C7 ATAAC)	Diesel	216	0.3618	0.359	0.300	1.971	5.369	0.010	0.183	0.169	852.450	0.058	0.000
2015	CAT AP-1055B Paver (C7)	Diesel	174	0.4154	0.433	0.362	5.121	5.537	0.010	0.277	0.255	852.450	0.096	0.000
2015	CAT CS74 Roller (C6.6 ACERT)	Diesel	143	0.3752	0.322	0.269	4.860	4.630	0.010	0.215	0.198	852.450	0.078	0.000
2015	CAT D8R Bull Dozer (3406C SCAC)	Diesel	328	0.3953	0.626	0.524	4.012	7.997	0.008	0.373	0.343	852.450	0.085	0.000
2015	CAT TL 1055 Forklift (C4.4 EIDITAAC)	Diesel	125	0.201	0.500	0.419	5.020	6.135	0.010	0.335	0.308	852.450	0.064	0.000
2015	CAT 345 CL Excavator (C13 ACERT)	Diesel	321	0.3819	0.205	0.172	1.811	3.214	0.008	0.104	0.096	852.450	0.052	0.000
2015	Delmag 30/32 Pile Hammer	Diesel	81	0.3417	0.673	0.563	5.470	6.502	0.010	0.553	0.509	852.450	0.092	0.000
2015	Manitowoc 12000 Large Crane (332 hp)	Diesel	332	0.2881	0.420	0.351	2.208	6.124	0.008	0.253	0.233	852.450	0.059	0.000
2015	Mark II Ballast Tamper	Diesel	327	0.3417	0.312	0.261	1.831	4.425	0.008	0.167	0.154	852.450	0.054	0.000
2015	Rail Saw and Drill	Electrical	81	0.3417	0.673	0.563	5.470	6.502	0.010	0.553	0.509	852.450	0.092	0.000
2015	TEREX RT 555 Small Crane (Cummings QSB 185)	Diesel	208	0.2881	0.568	0.475	2.062	7.622	0.010	0.348	0.320	852.450	0.063	0.000
2016	Tug (1200HP) Idle	Diesel	1710	0.1	0.985	0.865	2.275	7.831	0.006	0.407	0.395	568.030	0.078	0.020
2016	Tug (1200HP) Maneuver	Diesel	1710	0.1	0.985	0.865	2.275	7.831	0.006	0.407	0.395	568.030	0.078	0.020
2016	Tug (1200HP) Transit	Diesel	1710	0.5	0.985	0.865	2.275	7.831	0.006	0.407	0.395	568.030	0.078	0.020
2016	Air Compressor	Electrical	78	0.3216	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	American 5299 Dynamic Compaction Crane	Diesel	208	0.2881	0.551	0.461	2.002	7.381	0.010	0.335	0.308	852.450	0.060	0.000
2016	Ballast Regulator	Diesel	240	0.3417	0.386	0.323	1.827	5.407	0.010	0.217	0.200	852.450	0.054	0.000
2016	Barge Crane	Diesel	208	0.2881	0.551	0.461	2.002	7.381	0.010	0.335	0.308	852.450	0.060	0.000
2016	Building Crane	Diesel	208	0.2881	0.551	0.461	2.002	7.381	0.010	0.335	0.308	852.450	0.060	0.000
2016	CAT 14H Motor Grader (C11)	Diesel	240	0.4087	0.352	0.295	1.950	5.663	0.010	0.184	0.169	852.450	0.056	0.000
2016	CAT 320D Excavator (C6.4 ACERT)	Diesel	148	0.3819	0.316	0.265	5.050	4.081	0.010	0.201	0.185	852.450	0.067	0.000
2016	CAT 416D Skip (3054C DIT)	Diesel	77	0.3685	0.476	0.398	5.701	5.142	0.010	0.396	0.364	852.450	0.078	0.000
2016	CAT 442E Backhoe (3054C DIT)	Diesel	78	0.3685	0.476	0.398	5.701	5.142	0.010	0.396	0.364	852.450	0.078	0.000
2016	CAT 627G Scraper (CAT C15/CAT C9 ACERT)	Diesel	394	0.4824	0.400	0.335	2.682	5.757	0.008	0.232	0.213	852.450	0.065	0.000
2016	CAT 815F Compactor (9 ACERT)	Diesel	253	0.3752	0.295	0.247	2.070	4.456	0.008	0.173	0.159	852.450	0.049	0.000
2016	CAT 966 Large Rubber Tire Loader (C7 ATAAC)	Diesel	216	0.3618	0.348	0.291	1.921	5.115	0.010	0.174	0.160	852.450	0.055	0.000
2016	CAT AP-1055B Paver (C7)	Diesel	174	0.4154	0.383	0.321	5.102	4.874	0.010	0.242	0.223	852.450	0.091	0.000
2016	CAT CS74 Roller (C6.6 ACERT)	Diesel	143	0.3752	0.299	0.250	4.849	4.239	0.010	0.197	0.181	852.450	0.073	0.000
2016	CAT D8R Bull Dozer (3406C SCAC)	Diesel	328	0.3953	0.609	0.509	3.761	7.710	0.008	0.359	0.330	852.450	0.081	0.000
2016	CAT TL 1055 Forklift (C4.4 EIDITAAC)	Diesel	125	0.201	0.469	0.392	5.028	5.675	0.010	0.310	0.285	852.450	0.060	0.000
2016	CAT 345 CL Excavator (C13 ACERT)	Diesel	321	0.3819	0.189	0.158	1.769	2.815	0.008	0.091	0.083	852.450	0.049	0.000
2016	Delmag 30/32 Pile Hammer	Diesel	81	0.3417	0.633	0.529	5.430	6.144	0.010	0.518	0.476	852.450	0.084	0.000
2016	Manitowoc 12000 Large Crane (332 hp)	Diesel	332	0.2881	0.392	0.328	2.098	5.649	0.008	0.233	0.215	852.450	0.057	0.000
2016	Mark II Ballast Tamper	Diesel	327	0.3417	0.302	0.253	1.770	4.150	0.008	0.159	0.146	852.450	0.051	0.000
2016	Rail Saw and Drill	Electrical	81	0.3417	0.633	0.529	5.430	6.144	0.010	0.518	0.476	852.450	0.084	0.000
2016	TEREX RT 555 Small Crane (Cummings QSB 185)	Diesel	208	0.2881	0.551	0.461	2.002	7.381	0.010	0.335	0.308	852.450	0.060	0.000
2017	Tug (1200HP) Idle	Diesel	1710	0.1	1.001	0.879	2.298	7.900	0.006	0.417	0.404	568.030	0.079	0.020
2017	Tug (1200HP) Maneuver	Diesel	1710	0.1	1.001	0.879	2.298	7.900	0.006	0.417	0.404	568.030	0.079	0.020

Year	Equipment	Fuel	HP	LF	Emission Factors (g/hp-hr)									
					TOG	ROG	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	N2O
2017	Tug (1200HP) Transit	Diesel	1710	0.5	1.001	0.879	2.298	7.900	0.006	0.417	0.404	568.030	0.079	0.020
2017	Air Compressor	Electrical	78	0.3216	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	American 5299 Dynamic Compaction Crane	Diesel	208	0.2881	0.496	0.415	1.955	6.655	0.010	0.297	0.273	852.450	0.057	0.000
2017	Ballast Regulator	Diesel	240	0.3417	0.364	0.304	1.800	5.022	0.010	0.199	0.183	852.450	0.051	0.000
2017	Barge Crane	Diesel	208	0.2881	0.496	0.415	1.955	6.655	0.010	0.297	0.273	852.450	0.057	0.000
2017	Building Crane	Diesel	208	0.2881	0.496	0.415	1.955	6.655	0.010	0.297	0.273	852.450	0.057	0.000
2017	CAT 14H Motor Grader (C11)	Diesel	240	0.4087	0.350	0.293	1.906	5.525	0.010	0.180	0.166	852.449	0.053	0.000
2017	CAT 320D Excavator (C6.4 ACERT)	Diesel	148	0.3819	0.295	0.247	5.047	3.700	0.010	0.182	0.167	852.450	0.061	0.000
2017	CAT 416D Skip (3054C DIT)	Diesel	77	0.3685	0.443	0.370	5.672	4.809	0.010	0.362	0.333	852.450	0.071	0.000
2017	CAT 442E Backhoe (3054C DIT)	Diesel	78	0.3685	0.443	0.370	5.672	4.809	0.010	0.362	0.333	852.450	0.071	0.000
2017	CAT 627G Scraper (CAT C15/CAT C9 ACERT)	Diesel	394	0.4824	0.376	0.315	2.548	5.340	0.008	0.214	0.197	852.450	0.062	0.000
2017	CAT 815F Compactor (9 ACERT)	Diesel	253	0.3752	0.262	0.220	1.981	3.840	0.008	0.150	0.138	852.450	0.046	0.000
2017	CAT 966 Large Rubber Tire Loader (C7 ATAAC)	Diesel	216	0.3618	0.330	0.276	1.883	4.755	0.010	0.162	0.149	852.450	0.052	0.000
2017	CAT AP-1055B Paver (C7)	Diesel	174	0.4154	0.344	0.288	5.085	4.353	0.010	0.214	0.197	852.450	0.086	0.000
2017	CAT CS74 Roller (C6.6 ACERT)	Diesel	143	0.3752	0.278	0.232	4.840	3.874	0.010	0.180	0.166	852.450	0.068	0.000
2017	CAT D8R Bull Dozer (3406C SCAC)	Diesel	328	0.3953	0.585	0.490	3.533	7.333	0.008	0.341	0.313	852.450	0.077	0.000
2017	CAT TL 1055 Forklift (C4.4 EIDITAAC)	Diesel	125	0.201	0.449	0.376	5.034	5.362	0.010	0.294	0.270	852.450	0.056	0.000
2017	CAT 345 CL Excavator (C13 ACERT)	Diesel	321	0.3819	0.177	0.148	1.737	2.507	0.008	0.081	0.075	852.450	0.047	0.000
2017	Delmag 30/32 Pile Hammer	Diesel	81	0.3417	0.584	0.488	5.393	5.721	0.010	0.470	0.433	852.450	0.075	0.000
2017	Manitowoc 12000 Large Crane (332 hp)	Diesel	332	0.2881	0.363	0.303	2.008	5.232	0.008	0.212	0.195	852.450	0.054	0.000
2017	Mark II Ballast Tamper	Diesel	327	0.3417	0.295	0.247	1.725	3.949	0.008	0.152	0.140	852.450	0.049	0.000
2017	Rail Saw and Drill	Electrical	81	0.3417	0.584	0.488	5.393	5.721	0.010	0.470	0.433	852.450	0.075	0.000
2017	TEREX RT 555 Small Crane (Cummings QSB 185)	Diesel	208	0.2881	0.496	0.415	1.955	6.655	0.010	0.297	0.273	852.450	0.057	0.000
2018	Tug (1200HP) Idle	Diesel	1710	0.1	1.017	0.894	2.322	7.969	0.006	0.426	0.413	568.030	0.080	0.020
2018	Tug (1200HP) Maneuver	Diesel	1710	0.1	1.017	0.894	2.322	7.969	0.006	0.426	0.413	568.030	0.080	0.020
2018	Tug (1200HP) Transit	Diesel	1710	0.5	1.017	0.894	2.322	7.969	0.006	0.426	0.413	568.030	0.080	0.020
2018	Air Compressor	Electrical	78	0.3216	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2018	American 5299 Dynamic Compaction Crane	Diesel	208	0.2881	0.427	0.357	1.917	5.773	0.010	0.250	0.230	852.450	0.054	0.000
2018	Ballast Regulator	Diesel	240	0.3417	0.268	0.224	1.779	3.648	0.010	0.135	0.124	852.450	0.048	0.000
2018	Barge Crane	Diesel	208	0.2881	0.427	0.357	1.917	5.773	0.010	0.250	0.230	852.450	0.054	0.000
2018	Building Crane	Diesel	208	0.2881	0.427	0.357	1.917	5.773	0.010	0.250	0.230	852.450	0.054	0.000
2018	CAT 14H Motor Grader (C11)	Diesel	240	0.4087	0.340	0.284	1.871	5.271	0.010	0.171	0.158	852.449	0.050	0.000
2018	CAT 320D Excavator (C6.4 ACERT)	Diesel	148	0.3819	0.241	0.202	5.045	2.924	0.010	0.142	0.130	852.450	0.056	0.000
2018	CAT 416D Skip (3054C DIT)	Diesel	77	0.3685	0.372	0.311	5.646	4.154	0.010	0.294	0.271	852.450	0.065	0.000
2018	CAT 442E Backhoe (3054C DIT)	Diesel	78	0.3685	0.372	0.311	5.646	4.154	0.010	0.294	0.271	852.450	0.065	0.000
2018	CAT 627G Scraper (CAT C15/CAT C9 ACERT)	Diesel	394	0.4824	0.326	0.273	2.431	4.568	0.008	0.180	0.166	852.450	0.059	0.000
2018	CAT 815F Compactor (9 ACERT)	Diesel	253	0.3752	0.216	0.181	1.908	3.098	0.008	0.119	0.110	852.450	0.044	0.000
2018	CAT 966 Large Rubber Tire Loader (C7 ATAAC)	Diesel	216	0.3618	0.295	0.247	1.852	4.131	0.010	0.140	0.129	852.450	0.049	0.000
2018	CAT AP-1055B Paver (C7)	Diesel	174	0.4154	0.300	0.251	5.072	3.747	0.010	0.183	0.168	852.450	0.082	0.000
2018	CAT CS74 Roller (C6.6 ACERT)	Diesel	143	0.3752	0.235	0.196	4.832	3.181	0.010	0.147	0.135	852.450	0.064	0.000
2018	CAT D8R Bull Dozer (3406C SCAC)	Diesel	328	0.3953	0.529	0.443	3.329	6.502	0.008	0.300	0.276	852.450	0.073	0.000
2018	CAT TL 1055 Forklift (C4.4 EIDITAAC)	Diesel	125	0.201	0.378	0.316	5.034	4.430	0.010	0.241	0.222	852.450	0.052	0.000
2018	CAT 345 CL Excavator (C13 ACERT)	Diesel	321	0.3819	0.154	0.129	1.710	2.050	0.008	0.066	0.061	852.450	0.044	0.000

Year	Equipment	Fuel	HP	LF	Emission Factors (g/hp-hr)									
					TOG	ROG	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	N2O
2018	Delmag 30/32 Pile Hammer	Diesel	81	0.3417	0.493	0.412	5.358	4.955	0.010	0.392	0.360	852.449	0.067	0.000
2018	Manitowoc 12000 Large Crane (332 hp)	Diesel	332	0.2881	0.327	0.274	1.934	4.634	0.008	0.187	0.172	852.450	0.051	0.000
2018	Mark II Ballast Tamper	Diesel	327	0.3417	0.224	0.188	1.696	2.907	0.008	0.104	0.095	852.450	0.046	0.000
2018	Rail Saw and Drill	Electrical	81	0.3417	0.493	0.412	5.358	4.955	0.010	0.392	0.360	852.449	0.067	0.000
2018	TEREX RT 555 Small Crane (Cummings QSB 185)	Diesel	208	0.2881	0.427	0.357	1.917	5.773	0.010	0.250	0.230	852.450	0.054	0.000
2019	Tug (1200HP) Idle	Diesel	1710	0.1	1.034	0.908	2.345	8.039	0.006	0.435	0.422	568.030	0.082	0.020
2019	Tug (1200HP) Maneuver	Diesel	1710	0.1	1.034	0.908	2.345	8.039	0.006	0.435	0.422	568.030	0.082	0.020
2019	Tug (1200HP) Transit	Diesel	1710	0.5	1.034	0.908	2.345	8.039	0.006	0.435	0.422	568.030	0.082	0.020
2019	Air Compressor	Electrical	78	0.3216	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2019	American 5299 Dynamic Compaction Crane	Diesel	208	0.2881	0.377	0.316	1.883	5.084	0.010	0.216	0.198	852.450	0.051	0.000
2019	Ballast Regulator	Diesel	240	0.3417	0.229	0.191	1.762	3.020	0.010	0.106	0.097	852.450	0.045	0.000
2019	Barge Crane	Diesel	208	0.2881	0.377	0.316	1.883	5.084	0.010	0.216	0.198	852.450	0.051	0.000
2019	Building Crane	Diesel	208	0.2881	0.377	0.316	1.883	5.084	0.010	0.216	0.198	852.450	0.051	0.000
2019	CAT 14H Motor Grader (C11)	Diesel	240	0.4087	0.318	0.266	1.846	4.866	0.010	0.156	0.144	852.450	0.047	0.000
2019	CAT 320D Excavator (C6.4 ACERT)	Diesel	148	0.3819	0.218	0.182	5.043	2.533	0.010	0.122	0.112	852.450	0.052	0.000
2019	CAT 416D Skip (3054C DIT)	Diesel	77	0.3685	0.325	0.272	5.625	3.693	0.010	0.247	0.227	852.450	0.059	0.000
2019	CAT 442E Backhoe (3054C DIT)	Diesel	78	0.3685	0.325	0.272	5.625	3.693	0.010	0.247	0.227	852.450	0.059	0.000
2019	CAT 627G Scraper (CAT C15/CAT C9 ACERT)	Diesel	394	0.4824	0.303	0.254	2.330	4.156	0.008	0.163	0.150	852.450	0.056	0.000
2019	CAT 815F Compactor (9 ACERT)	Diesel	253	0.3752	0.207	0.173	1.846	2.908	0.008	0.111	0.102	852.450	0.042	0.000
2019	CAT 966 Large Rubber Tire Loader (C7 ATAAC)	Diesel	216	0.3618	0.274	0.229	1.828	3.745	0.010	0.126	0.116	852.450	0.046	0.000
2019	CAT AP-1055B Paver (C7)	Diesel	174	0.4154	0.264	0.221	5.060	3.245	0.010	0.159	0.146	852.450	0.077	0.000
2019	CAT CS74 Roller (C6.6 ACERT)	Diesel	143	0.3752	0.204	0.171	4.825	2.699	0.010	0.124	0.114	852.450	0.059	0.000
2019	CAT D8R Bull Dozer (3406C SCAC)	Diesel	328	0.3953	0.506	0.423	3.147	6.143	0.008	0.283	0.260	852.450	0.070	0.000
2019	CAT TL 1055 Forklift (C4.4 EIDITAAC)	Diesel	125	0.201	0.338	0.283	5.031	3.865	0.010	0.210	0.193	852.450	0.048	0.000
2019	CAT 345 CL Excavator (C13 ACERT)	Diesel	321	0.3819	0.143	0.120	1.690	1.780	0.008	0.058	0.053	852.450	0.042	0.000
2019	Delmag 30/32 Pile Hammer	Diesel	81	0.3417	0.442	0.370	5.326	4.497	0.010	0.343	0.315	852.450	0.060	0.000
2019	Manitowoc 12000 Large Crane (332 hp)	Diesel	332	0.2881	0.309	0.258	1.871	4.297	0.008	0.173	0.159	852.450	0.049	0.000
2019	Mark II Ballast Tamper	Diesel	327	0.3417	0.211	0.176	1.676	2.575	0.008	0.092	0.085	852.449	0.044	0.000
2019	Rail Saw and Drill	Electrical	81	0.3417	0.442	0.370	5.326	4.497	0.010	0.343	0.315	852.450	0.060	0.000
2019	TEREX RT 555 Small Crane (Cummings QSB 185)	Diesel	208	0.2881	0.377	0.316	1.883	5.084	0.010	0.216	0.198	852.450	0.051	0.000

Table 4. Emissions factors for project construction related on-road sources.

Year	On-Road Vehicles	Veh Class	Vocation	Speed	Emission Factors (g/hr or g/mile)																
					TOG exh	TOG evap	ROG exh	ROG evap	CO	NOx	SOx	PM10 exh	PM10 tire	PM10 brk	PM2.5 exh	PM2.5 tire	PM2.5 brk	CO2	CH4	N2O
2012	Commuter Vehicle	LDA	Onsite Idle	Idle	2.436	0.000	1.785	0.000	22.138	1.543	0.017	0.085	0.040	0.184	0.078	0.010	0.079	5428.856	0.275	0.064
2012	Commuter Vehicle	LDA	Onsite Move	15	0.226	0.089	0.170	0.089	3.127	0.246	0.003	0.007	0.008	0.037	0.007	0.002	0.016	617.645	0.032	0.010
2012	Commuter Vehicle	LDA	Offsite Move	40	0.078	0.089	0.060	0.089	1.894	0.183	0.003	0.002	0.008	0.037	0.002	0.002	0.016	292.469	0.014	0.008
2012	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Idle	Idle	9.161	0.000	8.047	0.000	41.084	86.639	0.067	0.792	0.000	0.000	0.728	0.000	0.000	6974.119	0.374	0.000
2012	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Move	15	2.345	0.000	2.060	0.000	5.453	18.050	0.017	0.602	0.035	0.060	0.554	0.009	0.026	2729.289	0.096	0.060
2012	Kenworth Cummings 330 Delivery Truck	HHDT	Offsite Move	40	0.487	0.000	0.428	0.000	2.206	10.839	0.017	0.303	0.035	0.060	0.279	0.009	0.026	1702.091	0.020	0.060
2012	Peterbilt 357 Concrete Truck	HHDT	Onsite Idle	Idle	9.161	0.000	8.047	0.000	41.084	86.639	0.067	0.792	0.000	0.000	0.728	0.000	0.000	6974.119	0.374	0.000
2012	Peterbilt 357 Concrete Truck	HHDT	Onsite Move	15	2.345	0.000	2.060	0.000	5.453	18.050	0.017	0.602	0.035	0.060	0.554	0.009	0.026	2729.289	0.096	0.060
2012	Peterbilt 357 Concrete Truck	HHDT	Offsite Move	40	0.487	0.000	0.428	0.000	2.206	10.839	0.017	0.303	0.035	0.060	0.279	0.009	0.026	1702.091	0.020	0.060
2012	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Idle	Idle	9.161	0.000	8.047	0.000	41.084	86.639	0.067	0.792	0.000	0.000	0.728	0.000	0.000	6974.119	0.374	0.000
2012	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Move	15	2.345	0.000	2.060	0.000	5.453	18.050	0.017	0.602	0.035	0.060	0.554	0.009	0.026	2729.289	0.096	0.060
2012	Kenworth Cummings 350 Dbl Bottom	HHDT	Offsite Move	40	0.487	0.000	0.428	0.000	2.206	10.839	0.017	0.303	0.035	0.060	0.279	0.009	0.026	1702.091	0.020	0.060
2012	Peterbilt WT 4000 Water Truck	HHDT	Onsite Idle	Idle	9.161	0.000	8.047	0.000	41.084	86.639	0.067	0.792	0.000	0.000	0.728	0.000	0.000	6974.119	0.374	0.000
2012	Peterbilt WT 4000 Water Truck	HHDT	Onsite Move	15	2.345	0.000	2.060	0.000	5.453	18.050	0.017	0.602	0.035	0.060	0.554	0.009	0.026	2729.289	0.096	0.060
2012	Peterbilt WT 4000 Water Truck	HHDT	Offsite Move	40	0.487	0.000	0.428	0.000	2.206	10.839	0.017	0.303	0.035	0.060	0.279	0.009	0.026	1702.091	0.020	0.060
2012	Work Truck (Ford F350)	LHD1	Onsite Idle	Idle	3.188	0.000	2.800	0.000	17.336	37.488	0.025	0.659	0.060	0.382	0.607	0.015	0.164	2637.128	0.130	0.087
2012	Work Truck (Ford F350)	LHD1	Onsite Move	15	0.447	0.000	0.393	0.000	2.019	5.746	0.005	0.092	0.012	0.076	0.085	0.003	0.033	527.426	0.016	0.017
2012	Work Truck (Ford F350)	LHD1	Offsite Move	40	0.196	0.000	0.172	0.000	0.698	4.246	0.005	0.041	0.012	0.076	0.037	0.003	0.033	527.426	0.008	0.017
2013	Commuter Vehicle	LDA	Onsite Idle	Idle	2.083	0.000	1.505	0.000	19.150	1.349	0.017	0.075	0.040	0.184	0.068	0.010	0.079	5432.017	0.255	0.056
2013	Commuter Vehicle	LDA	Onsite Move	15	0.192	0.079	0.142	0.079	2.727	0.215	0.003	0.007	0.008	0.037	0.006	0.002	0.016	617.996	0.030	0.009
2013	Commuter Vehicle	LDA	Offsite Move	40	0.066	0.079	0.050	0.079	1.660	0.159	0.003	0.002	0.008	0.037	0.002	0.002	0.016	292.638	0.012	0.007
2013	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Idle	Idle	8.291	0.000	7.283	0.000	37.829	80.143	0.067	0.603	0.000	0.000	0.554	0.000	0.000	6995.573	0.338	0.000
2013	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Move	15	1.944	0.000	1.708	0.000	4.522	16.401	0.017	0.462	0.035	0.060	0.425	0.009	0.026	2731.137	0.079	0.060
2013	Kenworth Cummings 330 Delivery Truck	HHDT	Offsite Move	40	0.413	0.000	0.363	0.000	1.862	9.758	0.017	0.236	0.035	0.060	0.217	0.009	0.026	1703.244	0.017	0.060
2013	Peterbilt 357 Concrete Truck	HHDT	Onsite Idle	Idle	8.291	0.000	7.283	0.000	37.829	80.143	0.067	0.603	0.000	0.000	0.554	0.000	0.000	6995.573	0.338	0.000
2013	Peterbilt 357 Concrete Truck	HHDT	Onsite Move	15	1.944	0.000	1.708	0.000	4.522	16.401	0.017	0.462	0.035	0.060	0.425	0.009	0.026	2731.137	0.079	0.060
2013	Peterbilt 357 Concrete Truck	HHDT	Offsite Move	40	0.413	0.000	0.363	0.000	1.862	9.758	0.017	0.236	0.035	0.060	0.217	0.009	0.026	1703.244	0.017	0.060
2013	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Idle	Idle	8.291	0.000	7.283	0.000	37.829	80.143	0.067	0.603	0.000	0.000	0.554	0.000	0.000	6995.573	0.338	0.000
2013	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Move	15	1.944	0.000	1.708	0.000	4.522	16.401	0.017	0.462	0.035	0.060	0.425	0.009	0.026	2731.137	0.079	0.060
2013	Kenworth Cummings 350 Dbl Bottom	HHDT	Offsite Move	40	0.413	0.000	0.363	0.000	1.862	9.758	0.017	0.236	0.035	0.060	0.217	0.009	0.026	1703.244	0.017	0.060
2013	Peterbilt WT 4000 Water Truck	HHDT	Onsite Idle	Idle	8.291	0.000	7.283	0.000	37.829	80.143	0.067	0.603	0.000	0.000	0.554	0.000	0.000	6995.573	0.338	0.000
2013	Peterbilt WT 4000 Water Truck	HHDT	Onsite Move	15	1.944	0.000	1.708	0.000	4.522	16.401	0.017	0.462	0.035	0.060	0.425	0.009	0.026	2731.137	0.079	0.060
2013	Peterbilt WT 4000 Water Truck	HHDT	Offsite Move	40	0.413	0.000	0.363	0.000	1.862	9.758	0.017	0.236	0.035	0.060	0.217	0.009	0.026	1703.244	0.017	0.060
2013	Work Truck (Ford F350)	LHD1	Onsite Idle	Idle	3.115	0.000	2.736	0.000	17.212	35.533	0.025	0.636	0.060	0.382	0.585	0.015	0.164	2633.520	0.125	0.087
2013	Work Truck (Ford F350)	LHD1	Onsite Move	15	0.437	0.000	0.384	0.000	2.005	5.446	0.005	0.089	0.012	0.076	0.082	0.003	0.033	526.704	0.016	0.017
2013	Work Truck (Ford F350)	LHD1	Offsite Move	40	0.191	0.000	0.168	0.000	0.693	4.025	0.005	0.039	0.012	0.076	0.036	0.003	0.033	526.704	0.007	0.017
2014	Commuter Vehicle	LDA	Onsite Idle	Idle	1.770	0.000	1.253	0.000	16.432	1.188	0.017	0.067	0.040	0.184	0.061	0.010	0.079	5434.993	0.240	0.049
2014	Commuter Vehicle	LDA	Onsite Move	15	0.162	0.069	0.118	0.069	2.367	0.189	0.003	0.006	0.008	0.037	0.005	0.002	0.016	618.328	0.027	0.008
2014	Commuter Vehicle	LDA	Offsite Move	40	0.055	0.069	0.041	0.069	1.452	0.139	0.003	0.002	0.008	0.037	0.002	0.002	0.016	292.797	0.011	0.006
2014	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Idle	Idle	7.237	0.000	6.357	0.000	33.277	72.190	0.067	0.384	0.000	0.000	0.354	0.000	0.000	7022.554	0.295	0.000
2014	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Move	15	1.395	0.000	1.225	0.000	3.237	13.933	0.017	0.272	0.035	0.060	0.250	0.009	0.026	2736.437	0.057	0.060
2014	Kenworth Cummings 330 Delivery Truck	HHDT	Offsite Move	40	0.308	0.000	0.271	0.000	1.374	8.155	0.017	0.132	0.035	0.060	0.122	0.009	0.026	1706.549	0.013	0.060
2014	Peterbilt 357 Concrete Truck	HHDT	Onsite Idle	Idle	7.237	0.000	6.357	0.000	33.277	72.190	0.067	0.384	0.000	0.000	0.354	0.000	0.000	7022.554	0.295	0.000
2014	Peterbilt 357 Concrete Truck	HHDT	Onsite Move	15	1.395	0.000	1.225	0.000	3.237	13.933	0.017	0.272	0.035	0.060	0.250	0.009	0.026	2736.437	0.057	0.060
2014	Peterbilt 357 Concrete Truck	HHDT	Offsite Move	40	0.308	0.000	0.271	0.000	1.374	8.155	0.017	0.132	0.035	0.060	0.122	0.009	0.026	1706.549	0.013	0.060
2014	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Idle	Idle	7.237	0.000	6.357	0.000	33.277	72.190	0.067	0.384	0.000	0.000	0.354	0.000	0.000	7022.554	0.295	0.000
2014	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Move	15	1.395	0.000	1.225	0.000	3.237	13.933	0.017	0.272	0.035	0.060	0.250	0.009	0.026	2736.437	0.057	0.060
2014	Kenworth Cummings 350 Dbl Bottom	HHDT	Offsite Move	40	0.308	0.000	0.271	0.000	1.374	8.155	0.017	0.132	0.035	0.060	0.122	0.009	0.026	1706.549	0.013	0.060
2014	Peterbilt WT 4000 Water Truck	HHDT	Onsite Idle	Idle	7.237	0.000	6.357	0.000	33.277	72.190	0.067	0.384	0.000	0.000	0.354	0.000	0.000	7022.554	0.295	0.000
2014	Peterbilt WT 4000 Water Truck	HHDT	Onsite Move	15	1.395	0.000	1.225	0.000	3.237	13.933	0.017	0.272	0.035	0.060	0.250	0.009	0.026	2736.437	0.057	0.060

Year	On-Road Vehicles	Veh Class	Vocation	Speed	Emission Factors (g/hr or g/mile)														
					TOG exh	TOG evap	ROG exh	ROG evap	CO	NOx	SOx	PM10 exh	PM10 tire	PM10 brk	PM2.5 exh	PM2.5 tire	PM2.5 brk	CO2	CH4	N2O
2014	Peterbilt WT 4000 Water Truck	HHDT	Offsite Move	40	0.308	0.000	0.271	0.000	1.374	8.155	0.017	0.132	0.035	0.060	0.122	0.009	0.026	1706.549	0.013	0.060
2014	Work Truck (Ford F350)	LHD1	Onsite Idle	Idle	3.022	0.000	2.654	0.000	16.997	33.504	0.025	0.610	0.060	0.382	0.561	0.015	0.164	2629.819	0.125	0.087
2014	Work Truck (Ford F350)	LHD1	Onsite Move	15	0.424	0.000	0.372	0.000	1.980	5.135	0.005	0.086	0.012	0.076	0.079	0.003	0.033	525.964	0.015	0.017
2014	Work Truck (Ford F350)	LHD1	Offsite Move	40	0.186	0.000	0.163	0.000	0.684	3.795	0.005	0.037	0.012	0.076	0.034	0.003	0.033	525.964	0.007	0.017
2015	Commuter Vehicle	LDA	Onsite Idle	Idle	1.516	0.000	1.051	0.000	14.202	1.058	0.017	0.062	0.040	0.184	0.057	0.010	0.079	5438.153	0.230	0.044
2015	Commuter Vehicle	LDA	Onsite Move	15	0.138	0.062	0.098	0.062	2.071	0.168	0.003	0.005	0.008	0.037	0.005	0.002	0.016	618.683	0.025	0.007
2015	Commuter Vehicle	LDA	Offsite Move	40	0.046	0.062	0.034	0.062	1.281	0.122	0.003	0.002	0.008	0.037	0.002	0.002	0.016	292.967	0.010	0.005
2015	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Idle	Idle	7.274	0.000	6.389	0.000	34.359	66.240	0.067	0.305	0.000	0.000	0.281	0.000	0.000	7030.165	0.297	0.000
2015	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Move	15	1.196	0.000	1.051	0.000	2.688	12.020	0.017	0.177	0.035	0.060	0.163	0.009	0.026	2727.218	0.049	0.060
2015	Kenworth Cummings 330 Delivery Truck	HHDT	Offsite Move	40	0.271	0.000	0.238	0.000	1.163	6.944	0.017	0.095	0.035	0.060	0.087	0.009	0.026	1700.800	0.011	0.060
2015	Peterbilt 357 Concrete Truck	HHDT	Onsite Idle	Idle	7.274	0.000	6.389	0.000	34.359	66.240	0.067	0.305	0.000	0.000	0.281	0.000	0.000	7030.165	0.297	0.000
2015	Peterbilt 357 Concrete Truck	HHDT	Onsite Move	15	1.196	0.000	1.051	0.000	2.688	12.020	0.017	0.177	0.035	0.060	0.163	0.009	0.026	2727.218	0.049	0.060
2015	Peterbilt 357 Concrete Truck	HHDT	Offsite Move	40	0.271	0.000	0.238	0.000	1.163	6.944	0.017	0.095	0.035	0.060	0.087	0.009	0.026	1700.800	0.011	0.060
2015	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Idle	Idle	7.274	0.000	6.389	0.000	34.359	66.240	0.067	0.305	0.000	0.000	0.281	0.000	0.000	7030.165	0.297	0.000
2015	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Move	15	1.196	0.000	1.051	0.000	2.688	12.020	0.017	0.177	0.035	0.060	0.163	0.009	0.026	2727.218	0.049	0.060
2015	Kenworth Cummings 350 Dbl Bottom	HHDT	Offsite Move	40	0.271	0.000	0.238	0.000	1.163	6.944	0.017	0.095	0.035	0.060	0.087	0.009	0.026	1700.800	0.011	0.060
2015	Peterbilt WT 4000 Water Truck	HHDT	Onsite Idle	Idle	7.274	0.000	6.389	0.000	34.359	66.240	0.067	0.305	0.000	0.000	0.281	0.000	0.000	7030.165	0.297	0.000
2015	Peterbilt WT 4000 Water Truck	HHDT	Onsite Move	15	1.196	0.000	1.051	0.000	2.688	12.020	0.017	0.177	0.035	0.060	0.163	0.009	0.026	2727.218	0.049	0.060
2015	Peterbilt WT 4000 Water Truck	HHDT	Offsite Move	40	0.271	0.000	0.238	0.000	1.163	6.944	0.017	0.095	0.035	0.060	0.087	0.009	0.026	1700.800	0.011	0.060
2015	Work Truck (Ford F350)	LHD1	Onsite Idle	Idle	2.922	0.000	2.567	0.000	16.763	31.541	0.025	0.585	0.060	0.382	0.538	0.015	0.164	2626.395	0.120	0.087
2015	Work Truck (Ford F350)	LHD1	Onsite Move	15	0.410	0.000	0.360	0.000	1.953	4.834	0.005	0.082	0.012	0.076	0.075	0.003	0.033	525.279	0.015	0.017
2015	Work Truck (Ford F350)	LHD1	Offsite Move	40	0.180	0.000	0.158	0.000	0.675	3.572	0.005	0.036	0.012	0.076	0.033	0.003	0.033	525.279	0.007	0.017
2016	Commuter Vehicle	LDA	Onsite Idle	Idle	1.310	0.000	0.886	0.000	12.352	0.952	0.017	0.059	0.040	0.184	0.054	0.010	0.079	5441.175	0.220	0.040
2016	Commuter Vehicle	LDA	Onsite Move	15	0.118	0.056	0.082	0.056	1.826	0.151	0.003	0.005	0.008	0.037	0.005	0.002	0.016	619.025	0.023	0.006
2016	Commuter Vehicle	LDA	Offsite Move	40	0.039	0.056	0.028	0.056	1.138	0.109	0.003	0.002	0.008	0.037	0.001	0.002	0.016	293.129	0.009	0.005
2016	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Idle	Idle	6.812	0.000	5.984	0.000	33.311	60.057	0.067	0.162	0.000	0.000	0.149	0.000	0.000	7047.469	0.278	0.000
2016	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Move	15	1.018	0.000	0.894	0.000	2.214	10.434	0.017	0.107	0.035	0.060	0.098	0.009	0.026	2722.193	0.042	0.060
2016	Kenworth Cummings 330 Delivery Truck	HHDT	Offsite Move	40	0.243	0.000	0.214	0.000	1.009	5.934	0.017	0.074	0.035	0.060	0.068	0.009	0.026	1697.665	0.010	0.060
2016	Peterbilt 357 Concrete Truck	HHDT	Onsite Idle	Idle	6.812	0.000	5.984	0.000	33.311	60.057	0.067	0.162	0.000	0.000	0.149	0.000	0.000	7047.469	0.278	0.000
2016	Peterbilt 357 Concrete Truck	HHDT	Onsite Move	15	1.018	0.000	0.894	0.000	2.214	10.434	0.017	0.107	0.035	0.060	0.098	0.009	0.026	2722.193	0.042	0.060
2016	Peterbilt 357 Concrete Truck	HHDT	Offsite Move	40	0.243	0.000	0.214	0.000	1.009	5.934	0.017	0.074	0.035	0.060	0.068	0.009	0.026	1697.665	0.010	0.060
2016	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Idle	Idle	6.812	0.000	5.984	0.000	33.311	60.057	0.067	0.162	0.000	0.000	0.149	0.000	0.000	7047.469	0.278	0.000
2016	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Move	15	1.018	0.000	0.894	0.000	2.214	10.434	0.017	0.107	0.035	0.060	0.098	0.009	0.026	2722.193	0.042	0.060
2016	Kenworth Cummings 350 Dbl Bottom	HHDT	Offsite Move	40	0.243	0.000	0.214	0.000	1.009	5.934	0.017	0.074	0.035	0.060	0.068	0.009	0.026	1697.665	0.010	0.060
2016	Peterbilt WT 4000 Water Truck	HHDT	Onsite Idle	Idle	6.812	0.000	5.984	0.000	33.311	60.057	0.067	0.162	0.000	0.000	0.149	0.000	0.000	7047.469	0.278	0.000
2016	Peterbilt WT 4000 Water Truck	HHDT	Onsite Move	15	1.018	0.000	0.894	0.000	2.214	10.434	0.017	0.107	0.035	0.060	0.098	0.009	0.026	2722.193	0.042	0.060
2016	Peterbilt WT 4000 Water Truck	HHDT	Offsite Move	40	0.243	0.000	0.214	0.000	1.009	5.934	0.017	0.074	0.035	0.060	0.068	0.009	0.026	1697.665	0.010	0.060
2016	Work Truck (Ford F350)	LHD1	Onsite Idle	Idle	2.803	0.000	2.462	0.000	16.430	29.476	0.025	0.558	0.060	0.382	0.513	0.015	0.164	2623.158	0.115	0.087
2016	Work Truck (Ford F350)	LHD1	Onsite Move	15	0.393	0.000	0.345	0.000	1.914	4.518	0.005	0.078	0.012	0.076	0.072	0.003	0.033	524.632	0.014	0.017
2016	Work Truck (Ford F350)	LHD1	Offsite Move	40	0.172	0.000	0.151	0.000	0.661	3.339	0.005	0.034	0.012	0.076	0.032	0.003	0.033	524.632	0.007	0.017
2017	Commuter Vehicle	LDA	Onsite Idle	Idle	1.117	0.000	0.729	0.000	10.611	0.863	0.017	0.057	0.040	0.184	0.053	0.010	0.079	5443.407	0.215	0.036
2017	Commuter Vehicle	LDA	Onsite Move	15	0.099	0.050	0.066	0.050	1.599	0.136	0.003	0.005	0.008	0.037	0.005	0.002	0.016	619.277	0.022	0.006
2017	Commuter Vehicle	LDA	Offsite Move	40	0.032	0.050	0.022	0.050	1.008	0.097	0.003	0.001	0.008	0.037	0.001	0.002	0.016	293.249	0.008	0.004
2017	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Idle	Idle	6.971	0.000	6.124	0.000	34.250	56.063	0.067	0.135	0.000	0.000	0.124	0.000	0.000	7047.255	0.284	0.000
2017	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Move	15	0.966	0.000	0.848	0.000	2.087	9.365	0.017	0.086	0.035	0.060	0.079	0.009	0.026	2717.210	0.039	0.060
2017	Kenworth Cummings 330 Delivery Truck	HHDT	Offsite Move	40	0.235	0.000	0.206	0.000	0.966	5.286	0.017	0.066	0.035	0.060	0.060	0.009	0.026	1694.558	0.010	0.060
2017	Peterbilt 357 Concrete Truck	HHDT	Onsite Idle	Idle	6.971	0.000	6.124	0.000	34.250	56.063	0.067	0.135	0.000	0.000	0.124	0.000	0.000	7047.255	0.284	0.000
2017	Peterbilt 357 Concrete Truck	HHDT	Onsite Move	15	0.966	0.000	0.848	0.000	2.087	9.365	0.017	0.086	0.035	0.060	0.079	0.009	0.026	2717.210	0.039	0.060
2017	Peterbilt 357 Concrete Truck	HHDT	Offsite Move	40	0.235	0.000	0.206	0.000	0.966	5.286	0.017	0.066	0.035	0.060	0.060	0.009	0.026	1694.558	0.010	0.060
2017	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Idle	Idle	6.971	0.000	6.124	0.000	34.250	56.063	0.067	0.135	0.000	0.000	0.124	0.000	0.000	7047.255	0.284	0.000
2017	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Move	15	0.966	0.000	0.848	0.000	2.087	9.365	0.017	0.086	0.035	0.060	0.079	0.009	0.026	2717.210	0.039	0.060
2017	Kenworth Cummings 350 Dbl Bottom	HHDT	Offsite Move	40	0.235	0.000	0.206	0.000	0.966	5.286	0.017	0.066	0.035	0.060	0.060	0.009	0.026	1694.558	0.010	0.060

Year	On-Road Vehicles	Veh Class	Vocation	Speed	Emission Factors (g/hr or g/mile)															
					TOG exh	TOG evap	ROG exh	ROG evap	CO	NOx	SOx	PM10 exh	PM10 tire	PM10 brk	PM2.5 exh	PM2.5 tire	PM2.5 brk	CO2	CH4	N2O
2017	Peterbilt WT 4000 Water Truck	HHDT	Onsite Idle	Idle	6.971	0.000	6.124	0.000	34.250	56.063	0.067	0.135	0.000	0.000	0.124	0.000	0.000	7047.255	0.284	0.000
2017	Peterbilt WT 4000 Water Truck	HHDT	Onsite Move	15	0.966	0.000	0.848	0.000	2.087	9.365	0.017	0.086	0.035	0.060	0.079	0.009	0.026	2717.210	0.039	0.060
2017	Peterbilt WT 4000 Water Truck	HHDT	Offsite Move	40	0.235	0.000	0.206	0.000	0.966	5.286	0.017	0.066	0.035	0.060	0.060	0.009	0.026	1694.558	0.010	0.060
2017	Work Truck (Ford F350)	LHD1	Onsite Idle	Idle	2.686	0.000	2.359	0.000	16.109	27.553	0.025	0.532	0.060	0.382	0.490	0.015	0.164	2619.977	0.110	0.087
2017	Work Truck (Ford F350)	LHD1	Onsite Move	15	0.377	0.000	0.331	0.000	1.876	4.223	0.005	0.075	0.012	0.076	0.069	0.003	0.033	523.995	0.014	0.017
2017	Work Truck (Ford F350)	LHD1	Offsite Move	40	0.165	0.000	0.145	0.000	0.648	3.121	0.005	0.033	0.012	0.076	0.030	0.003	0.033	523.995	0.006	0.017
2018	Commuter Vehicle	LDA	Onsite Idle	Idle	0.954	0.000	0.596	0.000	9.118	0.790	0.017	0.057	0.040	0.184	0.053	0.010	0.079	5445.238	0.205	0.033
2018	Commuter Vehicle	LDA	Onsite Move	15	0.083	0.045	0.053	0.045	1.406	0.124	0.003	0.005	0.008	0.037	0.005	0.002	0.016	619.486	0.021	0.005
2018	Commuter Vehicle	LDA	Offsite Move	40	0.026	0.045	0.017	0.045	0.897	0.086	0.003	0.001	0.008	0.037	0.001	0.002	0.016	293.348	0.008	0.004
2018	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Idle	Idle	7.227	0.000	6.349	0.000	35.560	53.038	0.067	0.131	0.000	0.000	0.121	0.000	0.000	7044.947	0.295	0.000
2018	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Move	15	0.964	0.000	0.847	0.000	2.081	8.535	0.017	0.083	0.035	0.060	0.076	0.009	0.026	2712.765	0.039	0.060
2018	Kenworth Cummings 330 Delivery Truck	HHDT	Offsite Move	40	0.236	0.000	0.207	0.000	0.968	4.774	0.017	0.065	0.035	0.060	0.060	0.009	0.026	1691.786	0.010	0.060
2018	Peterbilt 357 Concrete Truck	HHDT	Onsite Idle	Idle	7.227	0.000	6.349	0.000	35.560	53.038	0.067	0.131	0.000	0.000	0.121	0.000	0.000	7044.947	0.295	0.000
2018	Peterbilt 357 Concrete Truck	HHDT	Onsite Move	15	0.964	0.000	0.847	0.000	2.081	8.535	0.017	0.083	0.035	0.060	0.076	0.009	0.026	2712.765	0.039	0.060
2018	Peterbilt 357 Concrete Truck	HHDT	Offsite Move	40	0.236	0.000	0.207	0.000	0.968	4.774	0.017	0.065	0.035	0.060	0.060	0.009	0.026	1691.786	0.010	0.060
2018	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Idle	Idle	7.227	0.000	6.349	0.000	35.560	53.038	0.067	0.131	0.000	0.000	0.121	0.000	0.000	7044.947	0.295	0.000
2018	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Move	15	0.964	0.000	0.847	0.000	2.081	8.535	0.017	0.083	0.035	0.060	0.076	0.009	0.026	2712.765	0.039	0.060
2018	Kenworth Cummings 350 Dbl Bottom	HHDT	Offsite Move	40	0.236	0.000	0.207	0.000	0.968	4.774	0.017	0.065	0.035	0.060	0.060	0.009	0.026	1691.786	0.010	0.060
2018	Peterbilt WT 4000 Water Truck	HHDT	Onsite Idle	Idle	7.227	0.000	6.349	0.000	35.560	53.038	0.067	0.131	0.000	0.000	0.121	0.000	0.000	7044.947	0.295	0.000
2018	Peterbilt WT 4000 Water Truck	HHDT	Onsite Move	15	0.964	0.000	0.847	0.000	2.081	8.535	0.017	0.083	0.035	0.060	0.076	0.009	0.026	2712.765	0.039	0.060
2018	Peterbilt WT 4000 Water Truck	HHDT	Offsite Move	40	0.236	0.000	0.207	0.000	0.968	4.774	0.017	0.065	0.035	0.060	0.060	0.009	0.026	1691.786	0.010	0.060
2018	Work Truck (Ford F350)	LHD1	Onsite Idle	Idle	2.564	0.000	2.252	0.000	15.769	25.674	0.025	0.506	0.060	0.382	0.466	0.015	0.164	2617.080	0.105	0.087
2018	Work Truck (Ford F350)	LHD1	Onsite Move	15	0.360	0.000	0.316	0.000	1.837	3.935	0.005	0.071	0.012	0.076	0.065	0.003	0.033	523.416	0.013	0.017
2018	Work Truck (Ford F350)	LHD1	Offsite Move	40	0.158	0.000	0.138	0.000	0.635	2.908	0.005	0.031	0.012	0.076	0.029	0.003	0.033	523.416	0.006	0.017
2019	Commuter Vehicle	LDA	Onsite Idle	Idle	0.839	0.000	0.504	0.000	8.039	0.734	0.017	0.057	0.040	0.184	0.053	0.010	0.079	5447.078	0.200	0.031
2019	Commuter Vehicle	LDA	Onsite Move	15	0.072	0.042	0.044	0.042	1.263	0.114	0.003	0.005	0.008	0.037	0.005	0.002	0.016	619.695	0.020	0.005
2019	Commuter Vehicle	LDA	Offsite Move	40	0.022	0.042	0.014	0.042	0.814	0.079	0.003	0.001	0.008	0.037	0.001	0.002	0.016	293.447	0.008	0.003
2019	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Idle	Idle	7.412	0.000	6.511	0.000	36.512	50.831	0.067	0.128	0.000	0.000	0.118	0.000	0.000	7043.794	0.302	0.000
2019	Kenworth Cummings 330 Delivery Truck	HHDT	Onsite Move	15	0.954	0.000	0.838	0.000	2.057	7.894	0.017	0.080	0.035	0.060	0.073	0.009	0.026	2709.401	0.039	0.060
2019	Kenworth Cummings 330 Delivery Truck	HHDT	Offsite Move	40	0.234	0.000	0.206	0.000	0.960	4.370	0.017	0.064	0.035	0.060	0.059	0.009	0.026	1689.688	0.010	0.060
2019	Peterbilt 357 Concrete Truck	HHDT	Onsite Idle	Idle	7.412	0.000	6.511	0.000	36.512	50.831	0.067	0.128	0.000	0.000	0.118	0.000	0.000	7043.794	0.302	0.000
2019	Peterbilt 357 Concrete Truck	HHDT	Onsite Move	15	0.954	0.000	0.838	0.000	2.057	7.894	0.017	0.080	0.035	0.060	0.073	0.009	0.026	2709.401	0.039	0.060
2019	Peterbilt 357 Concrete Truck	HHDT	Offsite Move	40	0.234	0.000	0.206	0.000	0.960	4.370	0.017	0.064	0.035	0.060	0.059	0.009	0.026	1689.688	0.010	0.060
2019	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Idle	Idle	7.412	0.000	6.511	0.000	36.512	50.831	0.067	0.128	0.000	0.000	0.118	0.000	0.000	7043.794	0.302	0.000
2019	Kenworth Cummings 350 Dbl Bottom	HHDT	Onsite Move	15	0.954	0.000	0.838	0.000	2.057	7.894	0.017	0.080	0.035	0.060	0.073	0.009	0.026	2709.401	0.039	0.060
2019	Kenworth Cummings 350 Dbl Bottom	HHDT	Offsite Move	40	0.234	0.000	0.206	0.000	0.960	4.370	0.017	0.064	0.035	0.060	0.059	0.009	0.026	1689.688	0.010	0.060
2019	Peterbilt WT 4000 Water Truck	HHDT	Onsite Idle	Idle	7.412	0.000	6.511	0.000	36.512	50.831	0.067	0.128	0.000	0.000	0.118	0.000	0.000	7043.794	0.302	0.000
2019	Peterbilt WT 4000 Water Truck	HHDT	Onsite Move	15	0.954	0.000	0.838	0.000	2.057	7.894	0.017	0.080	0.035	0.060	0.073	0.009	0.026	2709.401	0.039	0.060
2019	Peterbilt WT 4000 Water Truck	HHDT	Offsite Move	40	0.234	0.000	0.206	0.000	0.960	4.370	0.017	0.064	0.035	0.060	0.059	0.009	0.026	1689.688	0.010	0.060
2019	Work Truck (Ford F350)	LHD1	Onsite Idle	Idle	2.447	0.000	2.149	0.000	15.457	23.947	0.025	0.482	0.060	0.382	0.444	0.015	0.164	2614.410	0.100	0.087
2019	Work Truck (Ford F350)	LHD1	Onsite Move	15	0.343	0.000	0.301	0.000	1.800	3.670	0.005	0.068	0.012	0.076	0.062	0.003	0.033	522.882	0.013	0.017
2019	Work Truck (Ford F350)	LHD1	Offsite Move	40	0.150	0.000	0.132	0.000	0.622	2.712	0.005	0.030	0.012	0.076	0.027	0.003	0.033	522.882	0.006	0.017

3.0 Operations Emissions

Activity Data

Operation-related emissions were estimated for Project Option A – Working Waterfront scenario. On-road vehicle and linehaul locomotive emissions for the operation phase of the project were only estimated for the on-site portion of the activities. Off-site sources considered for the operation phase included ocean-going vessels while in their cruise mode, i.e., transiting between the Bay Bridge and the outer buoys outside the Golden Gate Bridge, and assist tugs while transiting to and from the vessel. These off-site operation phase emissions are reported as a separate line item in the emission summary tables.

Annual throughput and average work day activity levels for trucks, locomotives, cargo handling equipment (CHE), reefer gensets, ocean going vessels (OGVs) and associated assist tugs were provided to ENVIRON by Architectural Dimensions, and these data are listed in Table 5. Activities were assumed to remain constant throughout the operational phase of the Project.

With the exception of the "Function 7" drayage truck trips (i.e., drayage trips to and from other Port of Oakland marine terminals; see eighth row from top in Table 5), each one-way truck trip listed under functions 11 – 14 and 16 – 17 in Table 5 was assumed to include 20 minutes of movement at an average speed of 15 mph and 10 minutes of idling (5 on departure and 5 on arrival) for a total on-site engine-on period of 30 minutes per one-way trip. Each "Function 7" one-way drayage truck trip was assumed to include 10 minutes of movement at an average speed of 15 mph and 5 minutes of idling (2.5 on departure and 2.5 on arrival). These time estimates apply only to the on-site truck movements and do not include, for example, time spent waiting at entry gates to the marine terminals.

Employee commute vehicle trips data were not available at the time of this analysis and therefore they were not evaluated.

Table 5. Oakland Army Base project operation activities for Option A - Working Waterfront.

Function	Item	Units	Annual Volume	Mean Month	Annual work days	Volume per mean work day	Volume per mean calendar day	Quantity	Hours Each	Vehicle Hours per Day	% Drayage Trucks	% Onroad Trucks	Notes
1	Container trains	Trains	1,513	126	362	4.18	4.15	4 locomotives	4	66.32			Uses Existing Main Line Tracks
2	Bulk trains	Trains	260	22	260	1.00	0.71	4 locomotives	4	11.40			Uses Existing Main Line Tracks
3	Manifest trains	Trains	208	17	260	0.80	0.57	4 locomotives	4	9.12			Uses Existing Main Line Tracks
4	Switch Locomotive for Container Trains	Hours	1,765	147	362	4.88	4.84	1 locomotive		4.84			No off-site Movement
5	Switch Locomotive for Bulk Trains	Hours	910	76	260	3.50	2.49	1 locomotive		2.49			No off-site Movement
6	Terminal tractors to/from PAG marine terminal	Trips	400,000	33,333	362	1,105	1,096	Electric Vehicle	n/a	0			No emissions output
7	Drayage trucks to/from other P/Oak marine terminals	Trips	400,000	33,333	362	1,105	1,096	1 Truck	0.25	274	100%	0%	No off-site Movement; assume 0.25 hour operating on site per trip
8	Tractors moving Containers in Rail Yard	Hours	4,000	333	362	11	11	1 Forklift		11			No off-site Movement; assume all 11 hours are on-site
9	Reefer diesel genset	Hours	480,000	40,000	365	1,315	1,315	1 Generator Set		1,315			No off-site Movement
10	Ships	Vessels	53	4		n/a	0.15	1 Ship	8	1.16			
11	Transload - Rail to Warehouse	Trips	173,333	14,444	260	667	475	1 Truck	0.5	237	100%	0%	Assume 0.5 hour operating on site per trip
12	Transload - Trucks to Trucks	Trips	120,587	10,049	260	464	330	1 Truck	0.5	165	60%	40%	Assume 0.5 hour operating on site per trip
13	Heavy Industrial Buildings	Trips	94,900	7,908	260	365	260	1 Truck	0.5	130	0%	100%	Assume 0.5 hour operating on site per trip
14	Truck Terminals	Trips	319,410	26,618	260	1,229	875	1 Truck	0.5	438	78%	22%	Assume 0.5 hour operating on site per trip
15	Cranes	Each	400,000	33,333	362	1,105	1,096	7 Cranes	16	112			No emissions output
16	PL10 Truck Parking	Trips	277	23	260	1	0.76	1 Truck	0.5	0.38	78%	22%	Assume 0.5 hour operating on site per trip
17	PL11 Truck Parking	Trips	316	26	260	1	0.87	1 Truck	0.5	0.43	78%	22%	Assume 0.5 hour operating on site per trip

Linehaul locomotive operations are based on approximately 20 minutes of travel at 10 mph to traverse a round-trip length of 3.23 miles within the railyard (based on ENVIRON estimates). While in motion, the locomotive engines were assumed to operate 50% of time in notch 1 and 50% of time in notch 2 based on typical operations observed at other California rail yards. The engine is assumed to be idling for the rest of the 3 hours and 40 minutes spent on-site.

Each ship call to Berth 7 would consist of a series of activities, including transiting from the outer buoys outside the Golden Gate to the Bay Bridge, maneuvering between the Bay Bridge and Berth (Wharf) 7 and hoteling at Berth 7. OGV emissions are based on a typical Panamax class bulk carrier vessel with 9500 kW installed power for the main engine, 1340 kW for the auxiliary engine, and 146 kW for the boiler. OGV engine hours and engine load factors in each mode (transiting, maneuvering and berthing) were based on values developed for the Port of Oakland's emission inventory. Assist tug activity associated with each ship call was based on per call activity levels for Outer Harbor calls used in the Port's emission inventory.

Emissions from truck visits to the existing CASS, CWS North, and CWS South recycling facilities which are planned as part of the Proposed Project to relocate to the northeastern portion of the OAB were also estimated and subtracted from emissions associated with truck trips generated by the new facility. Activity data for the existing facilities were based on current average daily one-way trips of 150 for CASS, 86 for CWS North, and 129 for CWS South based on data obtained from the facility operators provided to ENVIRON via the City of Oakland. Each one-way trip included travel to or from the facility on city streets at an average speed of 25 mph and on a portion of the I-880 freeway within the modeling domain at an average speed of 55 mph.

Emission Factors

Emission factors for the tractor forklifts were modeled using OFFROAD 2011. Reefer genset emissions were estimated using CARB's TRU calculator. Because these two models provide only NOx, PM and HC emissions, ENVIRON supplemented the emissions estimates for all other pollutants using OFFROAD 2007 as per current CARB guidance. Horsepower and load factor assumptions were either obtained from manufacturer's spec sheets or default values from the emission models. Detailed emissions factors for the tractor and the reefer genset are presented in Table 6.

Table 6. Emissions factors for project operation related off-road sources.

					Emission Factors (g/hp-hr)									
Year	Equipment	Fuel	HP	LF	TOG	ROG	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	N2O
2020	Forklift	Diesel	125	0.201	0.299	0.250	5.028	3.320	0.010	0.180	0.165	852.450	0.045	0.000
2035	Forklift	Diesel	125	0.201	0.145	0.121	5.019	1.017	0.010	0.048	0.044	852.450	0.025	0.000
2020	Reefer	Diesel	34	0.46	0.879	0.736	7.706	3.121	0.013	0.015	0.014	977.810	0.066	0.000
2035	Reefer	Diesel	34	0.46	0.877	0.734	7.701	3.164	0.013	0.016	0.015	977.810	0.066	0.000

Emission factors for on-road vehicles were obtained from EMFAC2011. Again, PM exhaust, tire wear, and brake wear were included in the reported total PM emissions. However, road dust was not modeled. As shown in Table 5, the trucks were modeled either as a Port of Oakland (POAK) Drayage Truck or an average heavy-heavy duty truck (HHDT) as defined in the EMFAC model. The POAK Drayage Truck represents a heavy-heavy duty diesel drayage truck in the Bay Area, complying with the CARB's Drayage Truck Rule. An average HHDT is also modeled to comply with the CA Statewide Truck and Bus Rule. Functions 7 and 11 movements are conducted entirely by POAK drayage trucks because they operate on port property. Functions 12, 14, 16, and 17 movements are conducted by a mix of POAK drayage trucks and average HHDT; the fractions of each were calculated using the number of trips between origin and destination and determined if they are on port property. Function 13 refers to the new recycling facility in the City's Gateway Development area, which is considered non-port property and all trucks trips are modeled with average HHDT. Table 7 summarizes the on-road vehicle source emissions factors.

OGV propulsion and auxiliary engine emission factors were obtained from CARB technical support documentation for the OGV fuel rule.[8] Assist tug engine characteristics for 2020 were based on an analysis conducted in 2008 by ENVIRON in which individual tugs serving the Port of Oakland were identified and their relevant characteristics obtained from publicly available sources, including tug operator websites and a federal report listing individual vessel characteristics (USACE, 2009).[9] For the top three assist tug providers, ENVIRON constructed an "operator average" tug using the characteristics of each operator's individual tugs (horsepower ratings and model years of main and auxiliary engines). Tugs operated by the other four companies serving the Port were assumed to have characteristics similar to the average of the top three operators. Assist tug engines for the year of 2035 were assumed to comply with CARB's commercial harbor craft rule (California Regulations to Reduce Emissions from Diesel Engines on Commercial Harbor Craft Operated within California Waters and 24 Nautical Miles of the California Baseline, June 24, 2010). Assist tug engine emission factors were obtained from EPA (2008)[10] for each Tier level as required by calendar year under the California commercial harbor craft regulation. Resulting emissions per ship call are shown in Table 8.

Line-haul locomotive fleet characteristics for the years of 2020 and 2035 were based on EPA forecasts of national fleet fractions by Tier level (EPA, 2008)[11] and personal communication with Charles Moulis of EPA (January 8, 2009). Switch engines were assumed to be adequately represented by a GP-3x model with a EMD 16-645E pre-controlled engine. Switch engine emissions are based on emission factors reported by EPA (1998).[12] Table 9 lists the per trip line-haul locomotive and switcher emissions.

[8] CARB, 2011. Proposed Amendments to the Regulations, "Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels Within California Waters and 24 Nautical Miles of The California Baseline"; Appendix D: Emissions Estimation Methodology for Ocean-Going Vessels. May 2011.

[9] USACE. 2009. Personal communication and USACE volumes and distribution to disposal areas for 2008. US Army Corps of Engineers, December 15.

[10] EPA, 2008. Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder. EPA420-R-08-001.

[11] EPA, 2008. Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder. EPA420-R-08-001, March 2008.

[12] EPA, 1998. Locomotive Emission Standards Regulatory Support Document Appendix B: Locomotive Emission Data by Throttle Notch. United States Environmental Protection Agency Office of Mobile Sources, April 1998.

Table 7. Emissions factors for project operation related on-road sources.

Year	Veh Type	Fuel	Vocation	Speed	Emission Factors (g/hr or g/mile)													
					TOG	ROG	CO	NOx	SOx	PM10 exh	PM10 tire	PM10 brk	PM2.5 exh	PM2.5 tire	PM2.5 brk	CO2	CH4	N2O
2020	POAK Drayage Truck	Diesel	Onsite Idle	Idle	7.678	6.745	37.888	47.707	0.067	0.124	0.000	0.000	0.114	0.000	0.000	7043.954	0.313	0.000
2020	POAK Drayage Truck	Diesel	Onsite Idle	Idle	7.678	6.745	37.888	47.707	0.067	0.124	0.000	0.000	0.114	0.000	0.000	7043.954	0.313	0.000
2020	POAK Drayage / HHDT	Diesel	Onsite Idle	Idle	7.698	6.762	37.986	47.831	0.067	0.124	0.000	0.000	0.114	0.000	0.000	7062.237	0.314	0.000
2020	HHDT	Diesel	Onsite Idle	Idle	7.678	6.745	37.888	47.707	0.067	0.124	0.000	0.000	0.114	0.000	0.000	7043.954	0.313	0.000
2020	POAK Drayage / HHDT	Diesel	Onsite Idle	Idle	7.681	6.747	37.903	47.727	0.067	0.124	0.000	0.000	0.114	0.000	0.000	7046.821	0.313	0.000
2020	POAK Drayage / HHDT	Diesel	Onsite Idle	Idle	7.678	6.745	37.888	47.707	0.067	0.124	0.000	0.000	0.114	0.000	0.000	7043.954	0.313	0.000
2020	POAK Drayage / HHDT	Diesel	Onsite Idle	Idle	7.678	6.745	37.888	47.707	0.067	0.124	0.000	0.000	0.114	0.000	0.000	7043.954	0.313	0.000
2020	POAK Drayage Truck	Diesel	Onsite Move	15	2.019	1.774	4.314	14.563	0.017	0.104	0.036	0.062	0.096	0.009	0.026	2771.158	0.082	0.060
2020	POAK Drayage Truck	Diesel	Onsite Move	15	2.019	1.774	4.314	14.563	0.017	0.104	0.036	0.062	0.096	0.009	0.026	2771.158	0.082	0.060
2020	POAK Drayage / HHDT	Diesel	Onsite Move	15	1.597	1.403	3.415	11.575	0.017	0.092	0.036	0.061	0.085	0.009	0.026	2752.247	0.065	0.060
2020	HHDT	Diesel	Onsite Move	15	0.947	0.832	2.032	6.977	0.017	0.073	0.035	0.060	0.067	0.009	0.026	2705.716	0.039	0.060
2020	POAK Drayage / HHDT	Diesel	Onsite Move	15	1.788	1.570	3.821	12.924	0.017	0.097	0.036	0.061	0.090	0.009	0.026	2758.102	0.073	0.060
2020	POAK Drayage / HHDT	Diesel	Onsite Move	15	1.787	1.570	3.819	12.919	0.017	0.097	0.036	0.061	0.089	0.009	0.026	2756.980	0.073	0.060
2020	POAK Drayage / HHDT	Diesel	Onsite Move	15	1.787	1.570	3.819	12.919	0.017	0.097	0.036	0.061	0.089	0.009	0.026	2756.980	0.073	0.060
2035	POAK Drayage Truck	Diesel	Onsite Idle	Idle	8.407	7.385	41.661	38.550	0.067	0.108	0.000	0.000	0.099	0.000	0.000	7035.280	0.343	0.000
2035	POAK Drayage Truck	Diesel	Onsite Idle	Idle	8.407	7.385	41.661	38.550	0.067	0.108	0.000	0.000	0.099	0.000	0.000	7035.280	0.343	0.000
2035	POAK Drayage / HHDT	Diesel	Onsite Idle	Idle	8.429	7.404	41.769	38.650	0.067	0.108	0.000	0.000	0.100	0.000	0.000	7053.541	0.344	0.000
2035	HHDT	Diesel	Onsite Idle	Idle	8.407	7.385	41.661	38.550	0.067	0.108	0.000	0.000	0.099	0.000	0.000	7035.280	0.343	0.000
2035	POAK Drayage / HHDT	Diesel	Onsite Idle	Idle	8.411	7.388	41.678	38.566	0.067	0.108	0.000	0.000	0.099	0.000	0.000	7038.143	0.343	0.000
2035	POAK Drayage / HHDT	Diesel	Onsite Idle	Idle	8.407	7.385	41.661	38.550	0.067	0.108	0.000	0.000	0.099	0.000	0.000	7035.280	0.343	0.000
2035	POAK Drayage / HHDT	Diesel	Onsite Idle	Idle	8.407	7.385	41.661	38.550	0.067	0.108	0.000	0.000	0.099	0.000	0.000	7035.280	0.343	0.000
2035	POAK Drayage Truck	Diesel	Onsite Move	15	1.042	0.915	2.239	5.013	0.016	0.083	0.036	0.062	0.076	0.009	0.026	2683.516	0.043	0.059
2035	POAK Drayage Truck	Diesel	Onsite Move	15	1.042	0.915	2.239	5.013	0.016	0.083	0.036	0.062	0.076	0.009	0.026	2683.516	0.043	0.059
2035	POAK Drayage / HHDT	Diesel	Onsite Move	15	0.966	0.848	2.074	4.508	0.016	0.075	0.036	0.061	0.069	0.009	0.026	2690.545	0.039	0.059
2035	HHDT	Diesel	Onsite Move	15	0.844	0.741	1.811	3.715	0.016	0.063	0.035	0.060	0.058	0.009	0.026	2683.676	0.034	0.060
2035	POAK Drayage / HHDT	Diesel	Onsite Move	15	0.999	0.878	2.147	4.734	0.016	0.078	0.036	0.061	0.072	0.009	0.026	2684.643	0.041	0.059
2035	POAK Drayage / HHDT	Diesel	Onsite Move	15	0.999	0.877	2.146	4.732	0.016	0.078	0.036	0.061	0.072	0.009	0.026	2683.551	0.041	0.059
2035	POAK Drayage / HHDT	Diesel	Onsite Move	15	0.999	0.877	2.146	4.732	0.016	0.078	0.036	0.061	0.072	0.009	0.026	2683.551	0.041	0.059

Table 8. Emissions factors for project operation related marine sources.

Year	Vessel Type	Fuel	Vocation	Emission Factors (g/call)									
				TOG	ROG	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	N2O
2020	Panamax Bulk	Diesel	Cruising	30,300	26,615	37,923	579,474	12,756	8,660	8,102	20,903,749	2,436	806
2020	Panamax Bulk	Diesel	Maneuvering	5,923	5,203	4,073	35,443	589	654	710	1,004,115	108	33
2020	Panamax Bulk	Diesel	Hotelling	781	686	1,413	17,237	1,095	420	515	1,872,640	132	52
2020	Assist Tug	Diesel	Assisting	1,481	1,301	6,953	37,145	143	763	740	4,156,622	117	124
2020	Assist Tug	Diesel	Transiting	1,092	959	5,125	27,376	105	562	545	3,063,472	86	91
2035	Panamax Bulk	Diesel	Cruising	30,300	26,615	37,923	579,474	12,756	8,660	8,102	20,903,749	2,436	806
2035	Panamax Bulk	Diesel	Maneuvering	5,923	5,203	4,073	35,443	589	654	710	1,004,115	108	33
2035	Panamax Bulk	Diesel	Hotelling	781	686	1,413	17,237	1,095	420	515	1,872,640	132	52
2035	Assist Tug	Diesel	Assisting	332	291	6,953	8,862	143	199	193	4,156,622	26	124
2035	Assist Tug	Diesel	Transiting	244	215	5,125	6,531	105	147	142	3,063,472	19	91

Table 9. Emissions factors for project operation related rail sources.

Year	Loco Type	Fuel	Vocation	Speed	Emission Factors (g/trip for linehaul and g/hr for switcher)									
					TOG	ROG	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	N2O
2020	Loco-Linehaul	Diesel	Onsite Idle	Idle	913.0	705.2	829.4	8,005.0	3,646.9	149.0	137.1	469,065.8	19.4	3.9
2020	Switcher	Diesel	Onsite Idle	Idle	79.4	61.3	169.2	745.7	0.2	22.7	20.9	22,210.7	0.9	0.2
2020	Loco-Linehaul	Diesel	Onsite Move	Combined	191.2	147.7	273.7	3,438.6	1,709.2	59.9	55.1	219,835.3	9.1	1.8
2020	Switcher	Diesel	Onsite Move	Combined	87.7	67.8	195.7	2,975.1	0.8	57.5	52.9	85,360.1	3.5	0.7
2035	Loco-Linehaul	Diesel	Onsite Idle	Idle	441.3	340.9	488.6	5,166.0	3,295.2	38.7	35.6	423,831.3	17.5	3.6
2035	Switcher	Diesel	Onsite Idle	Idle	79.4	61.3	169.2	745.7	0.2	22.7	20.9	22,210.7	0.9	0.2
2035	Loco-Linehaul	Diesel	Onsite Move	Combined	137.1	105.9	252.2	2,619.4	2,172.4	33.4	30.7	284,488.9	11.7	2.4
2035	Switcher	Diesel	Onsite Move	Combined	87.7	67.8	195.7	2,975.1	0.8	57.5	52.9	85,360.1	3.5	0.7

General HRA Tables

Table A.1
Speciation Profiles for TOG
Oakland Army Base
Oakland, California

Source	CAS Number	Chemical	Fraction of TOG
On-road Diesel Trucks[1]	107028	acrolein	0.01297
	108383	xylene, m- & p-	0.008886455
	108883	toluene	0.015179438
	50000	formaldehyde	0.08505
	71432	benzene	0.01045
	75070	acetaldehyde	0.15942
	78933	methyl ethyl ketone (mek) (2-butanone)	0.028604469
	95476	o-xylene	0.003165561
Off-road Diesel Equipment, Ships, Tugs, and Generator Sets[2]	--	isomers of butylbenzene	0.00127
	--	isomers of diethylbenzene	0.00135
	--	ethylhexane	0.00061
	--	c9 aromatics	0.00497
	--	c10 aromatics	0.00079
	--	alkene ketone	0.01749
	--	c6 aldehydes	0.03799
	--	c5 aldehyde	0.0011
	100414	ethylbenzene	0.00305
	100425	styrene	0.00058
	100527	benzaldehyde	0.00699
	103651	n-propylbenzene	0.00122
	106423	p-xylene	0.00095
	106978	n-butane	0.00104
	106989	1-butene	0.00666
	106990	1,3-butadiene	0.0019
	107835	2-methylpentane	0.00392
	108087	2,4-dimethylpentane	0.00019
	108383	m-xylene	0.00611
	108678	1,3,5-trimethylbenzene	0.00194
	108872	methylcyclohexane	0.00068
	108883	toluene	0.01473
	108941	cyclohexanone	0.00107
	109660	n-pentane	0.00175
	109671	1-pentene	0.00324
	110543	n-hexane	0.00157
	110827	cyclohexane	0.00026
	111659	n-octane	0.0014
	111842	n-nonane	0.0023
	1120214	n-undecane	0.00261
	115071	propene	0.02597
	115117	2-methylpropene	0.00922
	123386	propionaldehyde	0.0097
	123728	butyraldehyde	0.01868
	124185	n-decane	0.00529
	135013	1,2-diethylbenzene	0.00086
	135988	(1-methylpropyl)benzene	0.00051
	142825	n-heptane	0.00068
	287923	cyclopentane	0.00012
	463490	1,2-propadiene	0.00466
	496117	2,3-dihydroindene (indan)	0.00188
	50000	formaldehyde	0.14714
	526738	1,2,3-trimethylbenzene	0.0012
	538932	(2-methylpropyl)benzene	0.00126
	540841	2,2,4-trimethylpentane	0.00298
	558372	3,3-dimethyl-1-butene	0.0282
	563780	2,3-dimethyl-1-butene	0.00028

Source	CAS Number	Chemical	Fraction of TOG
Off-road Diesel Equipment, Ships, Tugs, and Generator Sets[2]	565593	2,3-dimethylpentane	0.00073
	565753	2,3,4-trimethylpentane	0.00015
	584941	2,3-dimethylhexane	0.00011
	589344	3-methylhexane	0.00348
	589435	2,4-dimethylhexane	0.00036
	590181	cis-2-butene	0.00094
	591764	2-methylhexane	0.00115
	591786	methyl n-butyl ketone	0.00899
	592278	2-methylheptane	0.00057
	611143	1-methyl-2-ethylbenzene	0.00138
	620144	1-methyl-3-ethylbenzene	0.00247
	624646	trans-2-butene	0.00195
	627203	cis-2-pentene	0.0003
	637503	b-methylstyrene	0.00047
	64175	ethanol	0.00009
	646048	trans-2-pentene	0.0004
	67561	methanol	0.0003
	67641	acetone	0.07507
	71432	benzene	0.02001
	74828	methane	0.04084
	74840	ethane	0.00565
	74851	ethene	0.14377
	74862	acetylene	0.04254
	74986	propane	0.00185
	75070	acetaldehyde	0.07353
	75285	isobutane	0.01222
	75832	2,2-dimethylbutane	0.00061
	78784	2-methylbutane	0.00602
	78933	methyl ethyl ketone (mek) (2-butanone)	0.01477
	91203	naphthalene	0.00085
	95476	o-xylene	0.00335
	95636	1,2,4-trimethylbenzene	0.0053
	96140	3-methylpentane	0.00115
	96377	methylcyclopentane	0.00149
	98066	t-butylbenzene	0.00006
	98828	(1-methylethyl)benzene	0.00015
	--	unidentified	0.13862

Notes:

1. Speciation profile for On-road Diesel Trucks obtained from USEPA Speciation Profile 4674 for Medium Duty Trucks. Only air toxics as defined by Cal/EPA are shown here.

1. Speciation profile for Off-road Diesel Equipment, Ships, Tugs, and Generator Sets obtained from ARB Speciation Profile 818. In the past, BAAQMD has recommended adding acrolein to the USEPA speciation profile 3161 for farm equipment. However, BAAQMD now advises to use the USEPA profile without additions. Therefore, speciation profile 818 was used in this analysis.

Abbreviations:

ARB: Air Resources Board
BAAQMD: Bay Area Air Quality Management District
Cal/EPA: California Environmental Protection Agency
TOG: total organic gas
USEPA: United States Environmental Protection Agency

References:

ARB. 2010. Organic Profiles. October 27. Available online: http://www.arb.ca.gov/ei/speciate/dnldopt.htm
Cal/EPA. 2011. OEHHA/ARB Consolidated Table of Approved Risk Assessment Health Values. February 14. http://www.arb.ca.gov/toxics/healthval/contable.pdf
USEPA. 2004. Speciation Profile for Diesel Exhaust - Medium Duty Trucks #4674. Available online: http://cfpub.epa.gov/si/speciate/ehpa_speciate_browse_details.cfm?ptype=G&pnumber=4674

Table A.2
Toxicity Values[1]
Oakland Army Base
Oakland, California

Chemical	Cancer Potency Factor	Chronic Reference Exposure Level	Acute Reference Exposure Level
	[mg/kg-day]$^{-1}$	µg/m^3	µg/m^3
diesel PM	1.1	5	--
1,3-butadiene	0.6	20	--
acetaldehyde	0.01	140	470
acrolein	--	0.35	2.5
benzene	0.1	60	1300
ethylbenzene	0.0087	2000	--
formaldehyde	0.021	9	55
methanol	--	4000	28000
methyl ethyl ketone (mek) (2-butanone)	--	--	13000
m-xylene	--	700	22000
naphthalene	0.12	9	--
n-hexane	--	7000	--
o-xylene	--	700	22000
propene	--	3000	--
p-xylene	--	700	22000
styrene	--	900	21000
toluene	--	300	37000
xylene, m- & p-	--	700	22,000

Notes:

1. Values presented in this table reflect values used in this analysis for all toxic air contaminants identified ini the speciation profiles. If a "--" is reported, OEHHA does not report that toxicity for this chemical.

Abbreviations:

PM: Particulate Matter

[mg/kg-day]$^{-1}$: milligram per kilogram-day

µg/m^3: microgram per cubic meter

Sources:

California Environmental Protection Agency (Cal/EPA). 2011. OEHHA/ARB Consolidated Table of Approved Risk Assessment Health Values. February 14. http://www.arb.ca.gov/toxics/healthval/contable.pdf

Construction Tables

Table B.1
Modeling Parameters for Construction Sources
Oakland Army Base
Oakland, California

Work Area[1]	Number of Sources[2]	Unit Emission Rate[3]	Release Height[4]	Initial Vertical Dimension[5]	Initial Lateral Dimension[6]
		g/s	m	m	m
Site A	125	0.008	4.57	1.06	11.63
Site B	96	0.010	4.57	1.06	11.63
Site C	78	0.013	4.57	1.06	11.63
Site D	57	0.018	4.57	1.06	11.63
Site E	107	0.009	4.57	1.06	11.63
Site F	32	0.031	4.57	1.06	11.63
Wharf	17	0.059	4.57	1.06	11.63
Barge Crane	1	1.000	4.57	1.06	23.26
Excavator/Dozer between Stockpile and Conveyor Belt	14	0.071	4.57	1.06	23.26
Scraper/ Grader/ Water Truck between Conveyor Belt and Site A	11	0.091	4.57	1.06	23.26
Scraper/ Grader/ Water Truck between Conveyor Belt and Site B	1	1.000	4.57	1.06	23.26
Scraper/ Grader/ Water Truck between Conveyor Belt and Site C	6	0.167	4.57	1.06	23.26
Scraper/ Grader/ Water Truck between Conveyor Belt and Site D	14	0.071	4.57	1.06	23.26
Scraper/ Grader/ Water Truck between Conveyor Belt and Site F	10	0.100	4.57	1.06	23.26
Railyard	66	0.015	4.57	1.06	11.63
Maritime Street	37	0.027	4.57	1.06	23.26
West Burma	35	0.029	4.57	1.06	23.26
East Burma	11	0.091	4.57	1.06	23.26
7th Street Reconstruction	20	0.050	4.57	1.06	23.26
Tug - Running Emissions	232	0.004	6	1.40	23.26
Tug - Idling Emissions	2	0.500	6	1.40	23.26

Notes:
1. See Figures for Work Area locations.
2. Large volume sources were modeled as smaller adjacent volume sources. The number of sources is the number of volume sources with the dimensions specified needed to cover the area of emissions.
3. Dispersion of emissions was modeled using the χ/Q ("chi over q") method, such that each phase had unit emission rates (e.g., 1 gram per second [g/s]), and the model estimates dispersion factors (with units of [ug/m^3]/[g/s]). For volume sources, an unit emission rate is calculated as the inverse of the number of sources.
4. Release height consistent with previous ARB study (ARB 2000) .
5. Initial vertical dimension for all sources is represented by an elevated volume source not adjacent to a building, consistent with AERMOD guidance (USEPA 2004).
6. Initial lateral dimension was determined using AERMOD guidance (USEPA 2004). The spacing between volume sources in one source is 50 m. Gridded volume sources were considered single volume sources (Site A-F, Wharf and Railyard), whereas line sources (Scraper/Grader/Water Truck travel between the Conveyer belt to Site, Barge Crane, all roadway construction, and tugs) were modeled as line sources represented by volume sources.

Abbreviations:
µg/m^3 - microgram per cubic meter
ARB - Air Resources Board
g - gram
m - meter
s - second
USEPA - United States Environmental Protection Agency

Sources:
ARB. 2000. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. Appendix VII: Risk Characterization Scenarios. October.
USEPA. 2004. User's Guide for the AMS/EPA Regulatory Model - AERMOD. September. Available at: http://www.epa.gov/scram001/dispersion_prefrec.htm

Table B.2
Exposure Parameters - Construction
Oakland Army Base
Oakland, California

Exposure Parameter	Units	Resident Adult[2]	Resident Child[2]	School Child[3]	Daycare Child[4]	Recreational Adult[5]	Recreational Child[5]
Daily Breathing Rate (DBR)	[L/kg-day]	302	581	581	581	--	--
Hourly Breathing Rate (HBR)	[m^3/hour]	--	--	--	--	1.74	1.32
Exposure Time (ET)	[hours/24 hours]	24	24	10	10	1	1
Exposure Frequency (EF)	[days/year]	350	350	180	245	52	52
Exposure Duration for 2012-2014 (ED1)[1]	[years]	2.25	2.25	2.25	2.25	2.25	2.25
Exposure Duration for 2014-2019 (ED2)[1]	[years]	5.25	5.25	5.25	3.63	5.25	5.25
Averaging Time (AT)	[days]	25,550	25,550	25,550	25,550	25,550	25,550
Intake Factor for 2012-2014, Inhalation (IF_{inh}-1)	[m^3/kg-day]	0.0093	0.0179	0.0038	0.0052	0.0001	0.0003
Intake Factor for 2014-2019, Inhalation (IF_{inh}-2)	[m^3/kg-day]	0.0217	0.0418	0.0090	0.0084	0.0003	0.0002

Notes:

1. Exposure durations for Phase I and II reflect the actual construction schedules from 2012-2014 and October 2014 - December 2019, respectively, provided by Architectural Dimensions.

2. Exposure parameters other than exposure duration reflect default values for residents (BAAQMD 2010).

3. Exposure parameters other than exposure duration reflect default values for students (BAAQMD 2010).

4. Daily breathing rates for day care child receptors reflect default breathing rate (BAAQMD 2010). The day care centers were assumed to operate 10 hours per day from 7 AM to 5 PM. The day care child receptor was assumed to be at a day care center while the parents are at work; 245 days reflects the default exposure frequency for a worker (BAAQMD 2010).

5. Hourly breathing rates for recreational child and adult receptors reflect maximum recommended mean breathing rates based on moderate activities for short-term exposures for age groups from birth to 11 years and from 16 years to 70 years (USEPA 2011). The recreational child and adult receptors were conservatively assumed to be at a recreational location one hour per day, once a week, and 52 weeks per year.

Equation:

Residents, School Child, and Daycare Child:

$IF_{inh} = DBR * ET * EF * ED * CF1 / AT$

$CF1 = 0.001\ (m^3/L)$

Recreational User:

$IF_{inh} = HBR * ET * EF * ED * CF2 / Body\ Weight / AT$

Where: $Body\ Weight_{adult} = 63\ kg$ (Cal/EPA 2003)

$Body\ Weight_{child} = 18\ kg$ (Cal/EPA 2003)

$CF2 = 24\ hours/day$

Abbreviations:

-- not applicable
BAAQMD - Bay Area Air Quality Management District
kg - kilogram
L - Liter
m^3 - cubic meters
USEPA - US Environmental Protection Agency

Sources:

BAAQMD. 2010. BAAQMD Air Toxics NSR Program Health Risk Screening Analysis (HRSA) Guidelines. January.
USEPA. 2011. Exposure Factors Handbook: 2011 Edition. Table 6-2. September.

Table B.3
Age Sensitivity Factors (ASFs) - Construction[1]
Oakland Army Base
Oakland, California

Receptor	ASF for 2012-2014	Note	ASF for 2014-2019	Note
Resident Adult	1	2, 3	1	2, 3
Resident Child	10	2, 4	3	2, 9
School Child	3	2, 5	3	2, 5
Day Care Child	10	2, 6	3	2, 9
Recreational Adult	1	2, 7	1	2, 7
Recreational Child	10	2, 8	3	2, 9

Notes:

1. ASF based on recommendations by the Cal/EPA OEHHA (2009) and BAAQMD (2010).

2. Based on BAAQMD 2010.

3. A resident adult was assumed to be 16 years old and above.

4. A resident child was assumed to be exposed at some point from the third trimester of pregnancy to two years of age between 2012 and 2014.

5. A school child was assumed to be from 6 years old to 16 years old.

6. Daycare centers were conservatively assumed to accept children as young as 6 weeks old. Therefore, ASF for a day care child was conservatively estimated assuming exposure occurs from age 6 weeks to 2 years old between 2012 and 2014.

7. A recreational adult was assumed to be 16 years old and above.

8. A recreational child was assumed to represent age third trimester to 2 years between 2012 and 2014.

9. A resident child, day care child, and recreational child were assumed to be from 2 years old to 16 years old during the construction schedule from 2014 to 2019.

Abbreviations:
BAAQMD - Bay Area Air Quality Management District
Cal/EPA - California Environmental Protection Agency
OEHHA - Office of Environmental Health Hazard Assessment

Sources:
BAAQMD. 2010. BAAQMD Air Toxics NSR Program Health Risk Screening Analysis (HRSA) Guidelines. January.

OEHHA. 2009. Technical Support Document for Cancer Potency Factors: Methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures. May.

Table B.4
Cancer Risk, Chronic HI and PM Concentration from Project Construction
Oakland Army Base
Oakland, California

	Population	Annual Average Concentration			Chronic HI[3]	Excess Lifetime Cancer Risk[4]
		$PM_{2.5}$[1]	DPM[2]			
			July 2012 - Sept 2014	Oct 2014 - Dec 2019		
		$\mu g/m^3$			unitless	in a million
2002 Project[5]	Resident Child	0.35	0.27	0.38	0.077	107
	Resident Adult					12
2012 Project[5]	Resident Child	0.14	0.15	0.09	0.030	42
	Resident Adult					4
BAAQMD Threshold of Significance		**0.30**	**--**	**--**	**1**	**10**

Notes:
1. $PM_{2.5}$ concentration shown here represents the maximum annual average concentration associated with the construction activity from OAB at an offsite sensitive population.
2. DPM concentration shown here is the concentration at the MEISR for cancer risk. Concentrations and exposure were calculated for two time periods depending on the appropriate ASF and risks from each period were added together. Therefore, concentrations from the two periods are shown here.
3. The potential for exposure to result in chronic noncancer effects is evaluated by comparing the estimated annual average air concentration (which is equivalent to the average daily air concentration) to the chemical-specific noncancer chronic RELs presented in Table A.2. The maximum Chronic HI between the two periods is reported here.
4. The excess lifetime cancer risk assumes that an individual adjacent to the Project is exposed to all emissions. Cancer risks are estimated as the upper-bound incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to potential carcinogens. The estimated risk is expressed as a unitless probability. The cancer risks attributed to the emissions associated with construction were calculated based on the exposure point concentration (C), the intake factors presented in Table B.2, the CPF, and the ASFs. All receptors were assumed to be residents, the most conservative exposure scenario.
Calculation:
$Risk_{inh} = \Sigma Risk_{inh,i} = \Sigma C_i \times MAF \times CF \times IF_{inh} \times CPF_i \times ASF$
Where:
$Risk_{inh}$ = Cancer Risk; the incremental probability of an individual developing cancer as a result of inhalation exposure to a particular potential carcinogen (unitless)
$Risk_{inh,i}$ = Cancer Risk for Chemical i
C_i = Modeled Annual Average Concentration in air for Chemical i ($\mu g/m^3$)
MAF = Modeling Adjustment Factor
CF = Conversion Factor (mg/µg)
IF_{inh} = Intake Factor for Inhalation (m^3/kg-day)
CPF_i = Cancer Potency Factor for Chemical i (mg chemical/kg body weight-day)
ASF = Age Sensitivity Factor (used only to calculate risk using 2012 Standards)
5. 2012 concentrations were estimated using AERMOD, USEPA's preferred air dispersion model and emissions as described in the report. Modeling parameters and dispersion factors from the 2012 Project Scenario were also used to estimate concentration from the 2002 Project Scenario.

Abbreviations:
µg - microgram
ASF - age sensitivity factor
BAAQMD - Bay Area Air Quality Management District
CPF - cancer potency factor
DPM - Diesel Particulate Matter
HI - Hazard Index
kg - kilogram
m - meter
mg - milligram
MEISR - Maximally Exposed Individual Sensitive Receptor
OAB - Oakland Army Base
$PM_{2.5}$ - particulate matter
REL - Reference Exposure Level

Table B.5
Acute HI from Project Construction
Oakland Army Base
Oakland, California

Chemical	Acute REL	2002 Project[1]			Acute Hazard Quotient[3]	2012 Project[1]			Acute Hazard Quotient[2,3]
		1 Hour Concentration				1 Hour Concentration			
		Offroad Equipment	Onroad Equipment	Ships and Tugs		Offroad Equipment	Onroad Equipment	Ships and Tugs	
	[µg/m^3]	[µg/m^3]				[µg/m^3]			
Total TOG Concentration	--	1,744	963	23	--	454	331	28	--
acetaldehyde	470	128	153	1.7	0.60	33	53	2.1	0.19
acrolein	3	0	12	0	5.0	0	4.3	0	1.7
benzene	1,300	35	10.1	0.46	0.035	9.1	3.5	0.57	0.0101
formaldehyde	55	257	82	3.4	6.216	67	28	4.2	1.8
methanol	28,000	0.52	0	0.007	0.00002	0.14	0	0.008	0.000005
methyl ethyl ketone (mek) (2-butanone)	13,000	26	28	0.34	0.0041	6.7	9.5	0.42	0.0013
m-xylene	22,000	11	0	0.14	0.00049	2.8	0	0.17	0.00013
o-xylene	22,000	5.8	3.0	0.077	0.00041	1.5	1.0	0.095	0.00012
p-xylene	22,000	1.7	0	0.02	0.00008	0.43	0	0.03	0.00002
styrene	21,000	1.0	0	0.01	0.00005	0.26	0	0.02	0.00001
toluene	37,000	26	15	0.3	0.0011	6.7	5.0	0.42	0.00033
xylene, m- & p-	22,000	0	8.6	0	0.00039	0	2.9	0	0.00013
				Acute HI	**12**			**Acute HI**	**3.7**
				BAAQMD Significance Threshold	**1.0**			**BAAQMD Significance Threshold**	**1.0**

Notes:

1. Acute HI was evaluated for the 2002 Project Construction and 2012 Project Construction assuming a similar construction schedule and construction activity for both scenarios. Acute HI for the 2002 Project Scenario was evaluated at the MEISR for 2012 Project Scenario .
2. The maximum Acute HI was estimated assuming construction activity would occur as per the construction schedule provided by Architectural Dimensions.
3. The potential for exposure to result in acute noncancer effects is evaluated by comparing the estimated maximum hourly air concentration to the chemical-specific noncancer acute RELs. When calculated for a single chemical, the comparison yields a ratio termed a hazard quotient. The acute HI is calculated by summing each hazard quotient.

Calculation:

$\text{Acute HI} = \Sigma \text{Acute HQ}_i = \Sigma C_i / \text{REL}_i$

Where:

Acute HI = Acute Hazard Index
Acute HQ_i = Acute Hazard Quotient for Chemical i
C_i = Max hourly Air Concentration for Chemical i (µg/m^3)
REL_i = Noncancer Reference Exposure Level for Chemical i (µg/m^3)

Abbreviations:

µg/m^3: microgram per cubic meter
HI: Hazard Index
HQ: Hazard Quotient
MEISR - Maximally Exposed Individual Sensitive Receptor
REL: Reference Exposure Level
TOG: Total Organic Gases
UTM: Universal Transverse Coordinates

Construction Figures

Legend

Construction Area

- Railyard Construction
- Wharf Improvements
- Maritime St
- West Burma
- East Burma
- Seventh Street Reconstruction

Tug Operations

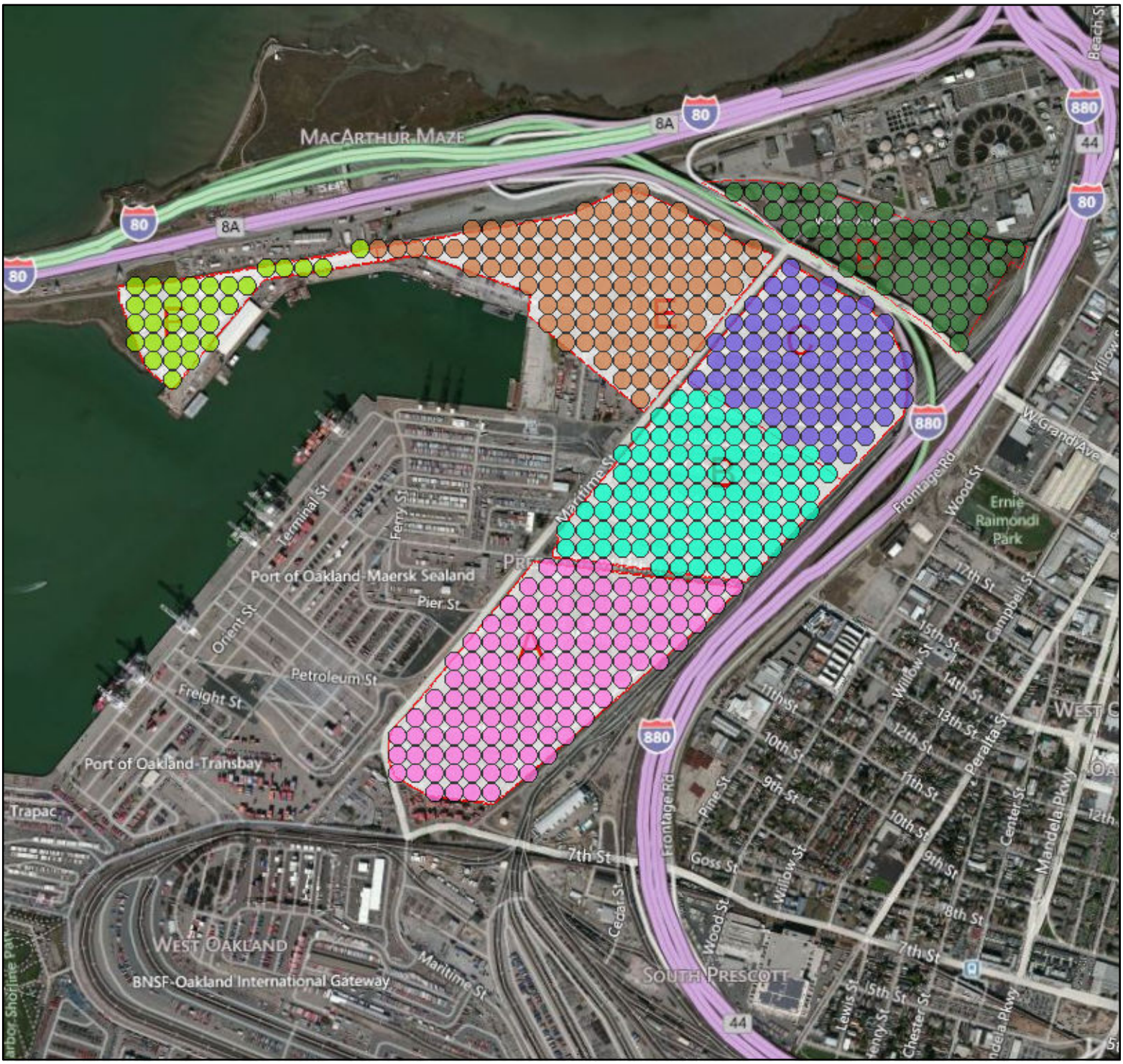
- Tug Idling
- Tug Route

N

0 0.125 0.25 0.5 Miles

Figure B.1
Construction Sources
Oakland Army Base
Oakland, California

ENVIRON



Legend

Construction Area

- Site A
- Site B
- Site C
- Site D
- Site E
- Site F

N

0 0.125 0.25 0.5 Miles

Figure B.2
Construction Sources
Oakland Army Base
Oakland, California

ENVIRON

Legend

Fill Routes

- to Site A
- to Site C
- to Site D
- to Site F
- To Conveyor

Tug Operations

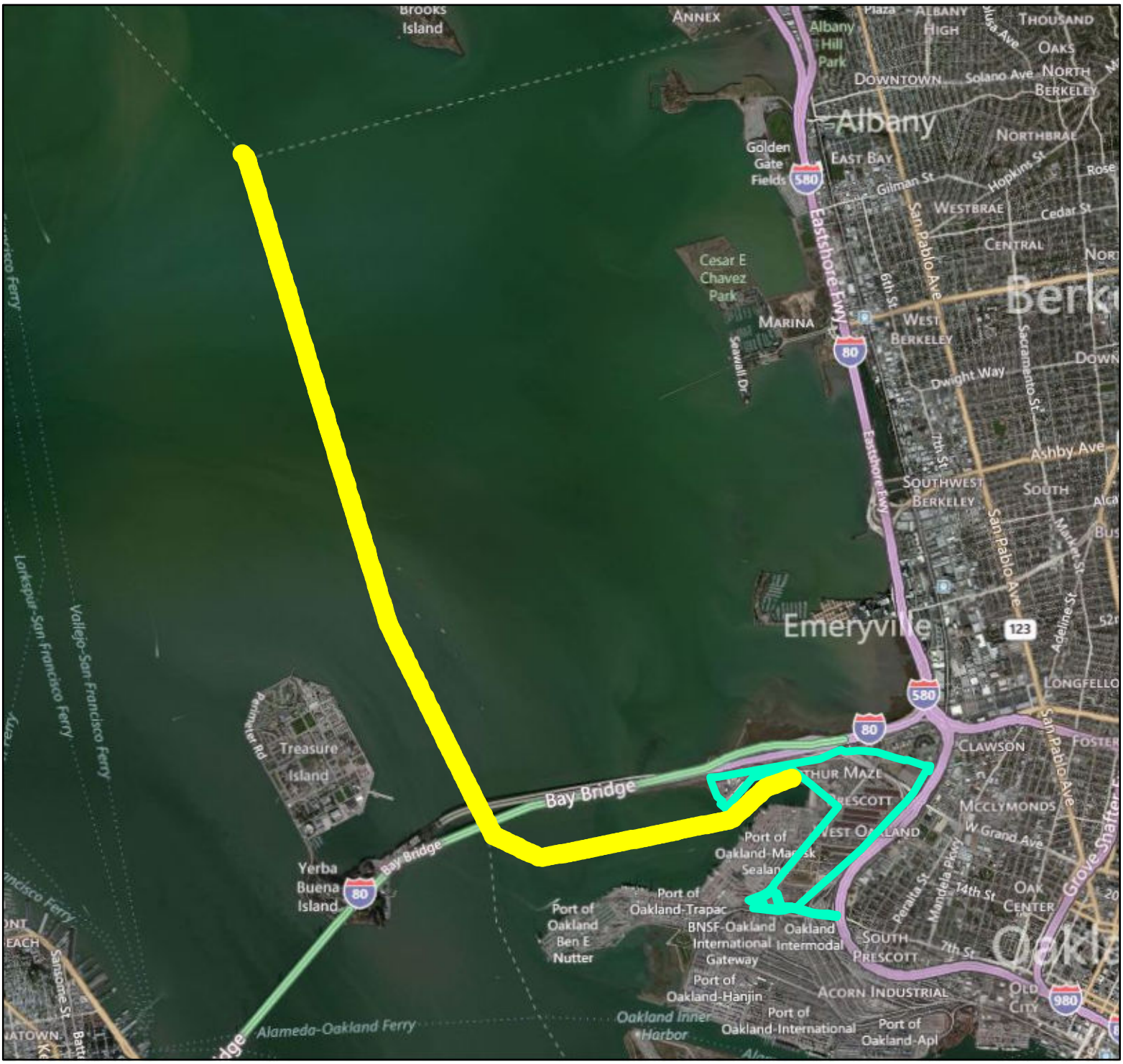
- Tug Idling
- Tug Route

N

0 0.125 0.25 0.5 Miles

Figure B.3
Construction Sources
Oakland Army Base
Oakland, California

ENVIRON



Legend

- Tug Route
- Site Boundary

N

0 0.5 1 2 Miles

Figure B.4
Construction Sources
Oakland Army Base
Oakland, California

ENVIRON

Operations Tables

Table C.1
Modeling Parameters for Operational Sources
Oakland Army Base
Oakland, California

Volume Sources

Function[1]	Equipment[2]	Details[3]	Number of Sources[4]	Unit Emission Rate[5]	Release Height[6]	Initial Vertical Dimension[7]	Initial Lateral Dimension[8]
				g/s	m	m	m
1	Container Trains	Day	74	1.35E-02	9.53	2.22	23.26
		Night	74	1.35E-02	18.37	4.27	23.26
2	Bulk Trains	Day	98	1.02E-02	9.53	2.22	23.26
		Night	98	1.02E-02	18.37	4.27	23.26
3	Manifest Trains	Day	107	9.35E-03	9.53	2.22	23.26
		Night	107	9.35E-03	18.37	4.27	23.26
4	Switching Locomotives for Container Trains	Day	74	1.35E-02	8.04	1.87	23.26
		Night	74	1.35E-02	13.43	3.12	23.26
5	Switching Locomotives for Bulk Trains	Day	98	1.02E-02	8.04	1.87	23.26
		Night	98	1.02E-02	13.43	3.12	23.26
7	Drayage Trucks to/from other P/Oak Marine Terminals		87	1.15E-02	4.57	1.06	23.26
10	Ships	Maneuvering	748	1.34E-03	50.00	11.63	11.63
		Cruising	132	7.58E-03	50.00	11.63	120.93
11	Transload - Rail to Warehouse	Line Source	39	4.39E-03	4.57	1.06	23.26
		Grid Source	189	4.39E-03	4.57	1.06	11.63
12	Transload - Trucks to Trucks	Northern Portion - Line Source	18	1.32E-02	4.57	1.06	23.26
		Northern Portion - Grid Source	58	1.32E-02	4.57	1.06	11.63
		Southern Portion - Line Source	28	1.23E-02	4.57	1.06	23.26
		Southern Portion - Grid Source	53	1.23E-02	4.57	1.06	11.63
13	Heavy Industrial Buildings	Line Source	13	2.08E-02	4.57	1.06	23.26
		Grid Source	35	2.08E-02	4.57	1.06	11.63
14	Truck Terminals	Onsite Route Portion	204	4.90E-03	4.57	1.06	11.63
		OGTIC Portion - Line Source	69	1.00E-02	4.57	1.06	23.26
		OGTIC Portion - Grid Source	31	1.00E-02	4.57	1.06	11.63
		Offsite Route Portion - Line Source	43	1.35E-02	4.57	1.06	23.26
		Offsite Route Portion - Grid Source	31	1.35E-02	4.57	1.06	11.63
16	Truck Parking - Northern Lot	Line Source	53	1.59E-02	4.57	1.06	23.26
		Grid Source	10	1.59E-02	4.57	1.06	11.63
	Truck Parking - Southern Lot	Line Source	53	1.49E-02	4.57	1.06	23.26
		Grid Source	14	1.49E-02	4.57	1.06	11.63
--	Truck Travel Offsite	I-880	161	6.21E-03	4.57	1.06	23.26
--		7th Street	25	4.00E-02	4.57	1.06	23.26
--		Grand Avenue	13	7.69E-02	4.57	1.06	23.26
Existing Recyclers	CWS Southern Facility Onsite Travel	Grid Source	183	5.46E-03	4.57	1.06	2.33
	CWS Northern Facility Onsite Travel	Grid Source	49	2.04E-02	4.57	1.06	2.33
	CASS Facility Onsite Travel	Grid Source	115	8.70E-03	4.57	1.06	2.33
	CWS Northern Facility Offsite Travel	Line Source	227	4.41E-03	4.57	1.06	4.65
	CASS Facility Offsite Travel	Line Source	303	3.30E-03	4.57	1.06	4.65
Idling	Truck Idling at Rail ROW	Volume Source	6	1	4.57	1.06	4.65

Area Sources

Function[1]	Equipment[2]	Unit Emission Rate[5]	Source Area[9]	Release Height[10]	Initial Vertical Dimension[7]
		g/[s-m^2]	m	m	m
8&9	Tractors - Moving Containers in Rail Yard & Reefer Diesel Gensets	1.4E-05	71,226	4.57	1.06

Point Sources

Function[1]	Equipment[2]	Details	Unit Emission Rate[5]	Stack Diameter[11]	Stack Height[11]	Stack Velocity[11]	Stack Temperature[11]
			g/s	m	m	m/s	K
10	Ships	Hoteling	1	0.50	43.00	16.00	618.00

Abbreviations:
CARB - California Air Resources Board
g - gram
m - meter
s - second
SCQAMD - South Coast Air Quality Management District
µg/m^3 - microgram per cubic meter
USEPA - United States Environmental Protection Agency

Notes:
1. Function of activity was identified by Architectural Dimensions.
2. Equipment associated with the function.
3. To take into account plume rise characteristics of rail exhaust associated with daytime (6PM to 6AM),and nighttime (6PM to 6AM), these times were modeled differently. For truck travel, a cluster of sources was modeled with a different initial lateral dimension than a line of sources. Depending on where the truck trips were expected to occur, the function was broken into multiple source areas.
4. Large volume sources were modeled as a grid or line of smaller volume sources. The number of sources is the number of volume sources with the dimensions specified needed to cover the area of emissions.
5. Dispersion of emissions was modeled using the χ/Q ("chi over q") method, such that each phase had unit emission rates (e.g., 1 gram per second [g/s]), and the model estimates dispersion factors (with units of [µg/m^3]/[g/s]). For volume sources, an unit emission rate is calculated as the inverse of the number of sources. For area sources, an unit emission rate is calculated as the inverse of the total area of the source.
6. Release height of on-road vehicle emissions was determined based on information from previous ARB study (ARB 2000) and recommendations by ARB staff. Release height of off-road equipment was determined based on data provided for a similar source (ENVIRON 2009).
7. The initial vertical dimension is consistent with an elevated volume source not adjacent to a building, based on AERMOD guidance (USEPA 2004).
8. Initial lateral dimension was determined using AERMOD guidance (USEPA 2004) and the Haul Road Workgroup recommendations (USEPA 2012). Gridded volume sources were considered single volume sources, whereas line sources (truck travel on roadways, vessel transit (cruising), and rail lines) were modeled as line sources represented by volume sources.
9. Area is the modeled area of the source, which was based on project planning documents.
10. Release height of off-road equipment was determined based on data provided for a similar source (ENVIRON 2009).
11. Stack parameters were based on data from other similar vessel and engineering judgment.

Sources:

CARB. 2000. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. Appendix VII: Risk Characterization Scenarios. October.
ENVIRON. 2009. Baseline Bay-Wide Regional Human Health Risk Assessment Tool for Diesel Exhaust Particulate Matter (DPM). Table B-1. December. Available at: http://www.cleanairactionplan.org/reports/documents.asp
SCAQMD. 2008 Localized Significance Threshold Methodology. July.
USEPA. 2004. User's Guide for the AMS/EPA Regulatory Model - AERMOD. September. Available at: http://www.epa.gov/scram001/dispersion_prefrec.htm
USEPA. 2012. Haul Road Workgroup Final Report Submission. March. Available at: http://www.epa.gov/ttn/scram/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf.

Table C.2
Exposure Parameters - Operation
Oakland Army Base
Oakland, California

Exposure Parameter	Units	Resident[1]	School Child[2]	Daycare Child[3]	Recreational User[4]
Daily Breathing Rate (DBR)	[L/kg-day]	302	581	581	--
Hourly Breathing Rate (HBR)	[m^3/hour]	--	--	--	1.56
Exposure Time (ET)	[hours/24 hours]	24	10	10	1
Exposure Frequency (EF)	[days/year]	350	180	245	52
Exposure Duration (ED)	[years]	70	9	5.88	70
Averaging Time (AT)	[days]	25,550	25,550	25,550	25,550
Intake Factor, Inhalation (IF_{inh})	[m^3/kg-day]	0.2896	0.0153	0.0137	0.0035

Notes:

1. Exposure parameters reflect default values for residents (BAAQMD 2010).

2. Exposure parameters reflect default values for students (BAAQMD 2010).

3. Daily breathing rates for day care child receptors reflect default breathing rates (BAAQMD 2010). The day care centers were assumed to operate 10 hours per day from 7 AM to 5 PM. The day care child receptor was assumed to be at a day care center while the parents are at work; 245 days reflects the default exposure frequency for a worker (BAAQMD 2010). It was assumed that a day care center would accept children from 6 weeks to 6 years old.

4. Hourly breathing rates for recreational user receptors reflect recommended mean breathing rates based on moderate activities for short-term exposures for age groups from birth to 70 years (USEPA 2011). The recreational user receptors were conservatively assumed to be at a recreational location 1 hours per day, once a week, and 52 weeks per year.

Equation:

Resident, School Child, and Daycare Child:

$IF_{inh} = DBR * ET * EF * ED * CF1 / AT$

$CF1 = 0.001$ (m^3/L)

Recreational User:

$IF_{inh} = HBR * ET * EF * ED * CF2 / Body\ Weight / AT$

Where: $Body\ Weight_{adult} = 63$ kg (Cal/EPA 2003)

$CF2 = 24$ hours/day

Abbreviations:

-- not available
BAAQMD - Bay Area Air Quality Management District
Cal/EPA - California Environmental Protection Agency
kg - kilogram
L - Liter
m^3 - cubic meters
USEPA - United States Environmental Protection Agency

Sources:

BAAQMD. 2010. *BAAQMD Air Toxics NSR Program Health Risk Screening Analysis (HRSA) Guidelines.* January.

Cal/EPA. 2003. Air Toxics Hot Spots Program Risk Assessment Guidelines: The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. Office of Environmental Health Hazard Assessment. August.

USEPA. 2011. Exposure Factors Handbook: 2011 Edition. Table 6-2. September.

Table C.3
Age Sensitivity Factors (ASFs) - Operation[1]
Oakland Army Base
Oakland, California

Receptor	Age Sensitivity Factor (ASF)
Resident[2,3]	1.7
School Child[2,4]	3
Day Care Child[2,5]	5.2
Recreational User[2,6]	1.7

Notes:
1. ASF based on recommendations by the Cal/EPA OEHHA (2009) and BAAQMD (2010).
2. Based on BAAQMD 2010.
3. A resident was assumed to represent lifetime exposure.
4. A school child was assumed to be from 6 years old to 16 years old.
5. Daycare centers were conservatively assumed to accept children from 6 weeks to 6 years old.
6. A recreational user was assumed to represent lifetime exposure.

Abbreviations:
BAAQMD - Bay Area Air Quality Management District
Cal/EPA - California Environmental Protection Agency
OEHHA - Office of Environmental Health Hazard Assessment

Sources:
BAAQMD. 2010. *BAAQMD Air Toxics NSR Program Health Risk Screening Analysis (HRSA) Guidelines.* January.

OEHHA. 2009. Technical Support Document for Cancer Potency Factors: Methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures. May.

Table C.4
Cancer Risk from Project Operation
Oakland Army Base
Oakland, California

	Annual Average Concentration			Chronic HI[3]	Excess Cancer Risk[4]	
	$PM_{2.5}$[1]	DPM[2]				
		2020-2034	2035-2090		*2002 Approach*	*2012 Approach*
	$\mu g/m^3$			unitless	in a million	
2002 Project[5]	0.47	0.51		0.103	84	278
2012 Project[6]	0.19	0.211	0.169	0.042	31	96
2012 Project without Reefers[7]	0.15	0.158	0.114	0.032	22	67
Increment	**-0.28**	**--**	**--**	**-0.061**	**-53**	**-182**
Increment without Reefers	**-0.33**	**--**	**--**	**-0.071**	**-62**	**-211**
BAAQMD Significance Threshold	**0.3**	**--**	**--**	**1**	**10**	

Notes:

1. $PM_{2.5}$ concentration shown here represents the maximum annual average concentration associated with the operational emissions of the entire OAB facility at an offsite sensitive population.
2. DPM concentration shown here is the concentration at the MEISR for cancer risk. For the 2012 Project, concentrations and exposure were calculated for two time periods and risk from each time period were added together. Therefore, concentrations from the two periods are shown here. OAB activity remains the same for both periods, but emissions from equipment are expected to decrease due to regulations and engine improvements.
3. The potential for exposure to result in chronic noncancer effects is evaluated by comparing the estimated annual average air concentration (which is equivalent to the average daily air concentration) to the chemical-specific noncancer chronic RELs presented in Table A.2. The maximum Chronic HI between the two periods is reported here.
4. The excess lifetime cancer risk assumes that an individual adjacent to the Project is exposed to all emissions. Cancer risks are estimated as the upper-bound incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to potential carcinogens. The estimated risk is expressed as a unitless probability. For this analysis, risks were calculated using two methods:
   -2002 approach to compare to the conclusions found in the 2002 EIR; and
   -2012 approach to estimate impacts of the Project using best available science.

The cancer risks attributed to the emissions associated with the Project were calculated based on the exposure point concentration (C), the intake factors presented in Table C.2, the CPF, and the ASFs. All receptors were assumed to be residents, the most conservative exposure scenario.

Calculation:

$Risk_{inh} = \Sigma Risk_{inh,i} = \Sigma C_i \times MAF \times CF \times IF_{inh} \times CPF_i \times ASF$

Where:

$Risk_{inh}$ = Cancer Risk; the incremental probability of an individual developing cancer as a result of inhalation exposure to a particular potential carcinogen (unitless)

$Risk_{inh,i}$ = Cancer Risk for Chemical i

C_i = Modeled Annual Average Concentration in air for Chemical i ($\mu g/m^3$)

MAF = Modeling Adjustment Factor

CF = Conversion Factor (mg/µg)

IF_{inh} = Intake Factor for Inhalation (m^3/kg-day)

CPF_i = Cancer Potency Factor for Chemical i (mg chemical/kg body weight-day)

ASF = Age Sensitivity Factor (used only to calculate risk using 2012 Standards)

5. 2002 Project concentrations were evaluated using modeling efforts from the 2002 EIR. Concentrations from sources exclusively outside of the OAB area were not included here.
6. 2012 Project impacts were estimated using AERMOD, USEPA's preferred air dispersion model and emissions as described in the report.
7. The 2002 Project did not estimate the impact of the diesel generators associated with Reefers, which would emit particulates as part of the 2002 Project. Therefore, for comparison purposes, the impact of these generator sets were removed here.

Abbreviations:

$\mu g/m^3$ - microgram per cubic meter
ASF - age sensitivity factor
CPF - cancer potency factor
DPM - diesel particulate matter
EIR - Environmental Impact Report
HI - Hazard Index
OAB - Oakland Army Base
$PM_{2.5}$ - particulate matter
REL - Reference Exposure Level
USEPA - United States Environmental Protection Agency

Table C.5
Acute HI from Project Operation
Oakland Army Base
Oakland, California

Chemical	1 Hour Concentration[1]				Acute REL	Acute Hazard Quotient[4]
	Offroad Equipment[2]	Rail[2]	Onroad Equipment[3]	Ships and Tugs[2]		
	µg/m^3				µg/m^3	
Total TOG Concentration	55	2.9	81	0.35	--	**--**
Acetaldehyde	4.05	0.21	13	0.026	470	0.0367
Acrolein	0	0	1.1	0	3	0.421
Benzene	1.1	0.058	0.85	0.007	1,300	0.0016
Formaldehyde	8.1	0.43	6.9	0.051	55	0.282
methanol	0.017	0.0009	0	0.0001	28,000	0.00000062
Methyl ethyl ketone (mek) (2-butanone)	0.81	0.043	2.32	0.005	13,000	0.000245
m-xylene	0.34	0.018	0	0.002	22,000	0.000016
o-Xylene	0.18	0.010	0.257	0.001	22,000	0.000021
p-xylene	0.052	0.003	0	0.0003	22,000	0.0000025
styrene	0.032	0.002	0	0.0002	21,000	0.0000016
Toluene	0.81	0.043	1.23	0.0051	37,000	0.000057
Xylene, m- & p-	0	0	0.72	0	22,000	0.00003
					Acute HI	**0.74**
					BAAQMD Significance Threshold	**1.0**

Notes:
1. The maximum Acute HI on an offsite sanative population was estimated assuming all operational equipment would operate at the same time.
2. Concentration of TOG from these equipment were speciated using ARB profile 818.
3. Concentration of TOG from these equipment were speciated using USEPA profile 4674.
4. The potential for exposure to result in acute noncancer effects is evaluated by comparing the estimated maximum hourly air concentration to the chemical-specific noncancer acute RELs. When calculated for a single chemical, the comparison yields a ratio termed a hazard quotient. The acute HI is calculated by summing each hazard quotient.

Calculation:

Acute HI = ΣAcute HQi = ΣCi / RELi

Where:

Acute HI = Acute Hazard Index
Acute HQi = Acute Hazard Quotient for Chemical i
Ci = Max hourly Air Concentration for Chemical i (µg/m^3)
RELi = Noncancer Reference Exposure Level for Chemical i (µg/m^3)

Abbreviations:
µg/m^3: microgram per cubic meter
ARB: California Air Resources Board
HI: Hazard Index
HQ: Hazard Quotient
REL: Reference Exposure level
USEPA: United States Environmental Protection Agency

Operations Figures

Legend

- Container Trains & Switching (F1, F4)
- Container Trains & Switching (F1, F4)
- Manifest Trains (F3)

N

0 0.125 0.25 0.5 Miles

Figure C.1
Operational Sources
Rail
Oakland Army Base
Oakland, California

ENVIRON

Legend

- Container Trains & Switching (F1, F4)
- Container Trains & Switching (F1, F4)
- Bulk Trains & Switching (F2, F5)

N

0 0.125 0.25 0.5 Miles

Figure C.2
Operational Sources
Rail
Oakland Army Base
Oakland, California

ENVIRON

Legend

- Drayage Truck Route (F07)

N

0 0.125 0.25 0.5 Miles

Figure C.3
Operational Sources
Drayage Truck Route (F7)
Oakland Army Base
Oakland, California

ENVIRON

Legend

- Trucks - Rail to Warehouse (F11)

N

0 0.125 0.25 0.5 Miles

Figure C.4
Operational Sources
Rail to Warehouse
Oakland Army Base
Oakland, California

ENVIRON

Legend

- Northern Portion of Trucks (F12)

N

0 0.125 0.25 0.5 Miles

Figure C.5
Operational Sources
Trucks to Trucks North
Oakland Army Base
Oakland, California

ENVIRON

Legend

- Southern Portion of Trucks (F12)

N

0 0.125 0.25 0.5 Miles

Figure C.6
Operational Sources
Trucks to Trucks South
Oakland Army Base
Oakland, California

ENVIRON

Legend

- Heavy Industrial (F13)

N

0 0.125 0.25 0.5 Miles

Figure C.7
Operational Sources
Heavy Industrial
Oakland Army Base
Oakland, California

ENVIRON

Legend

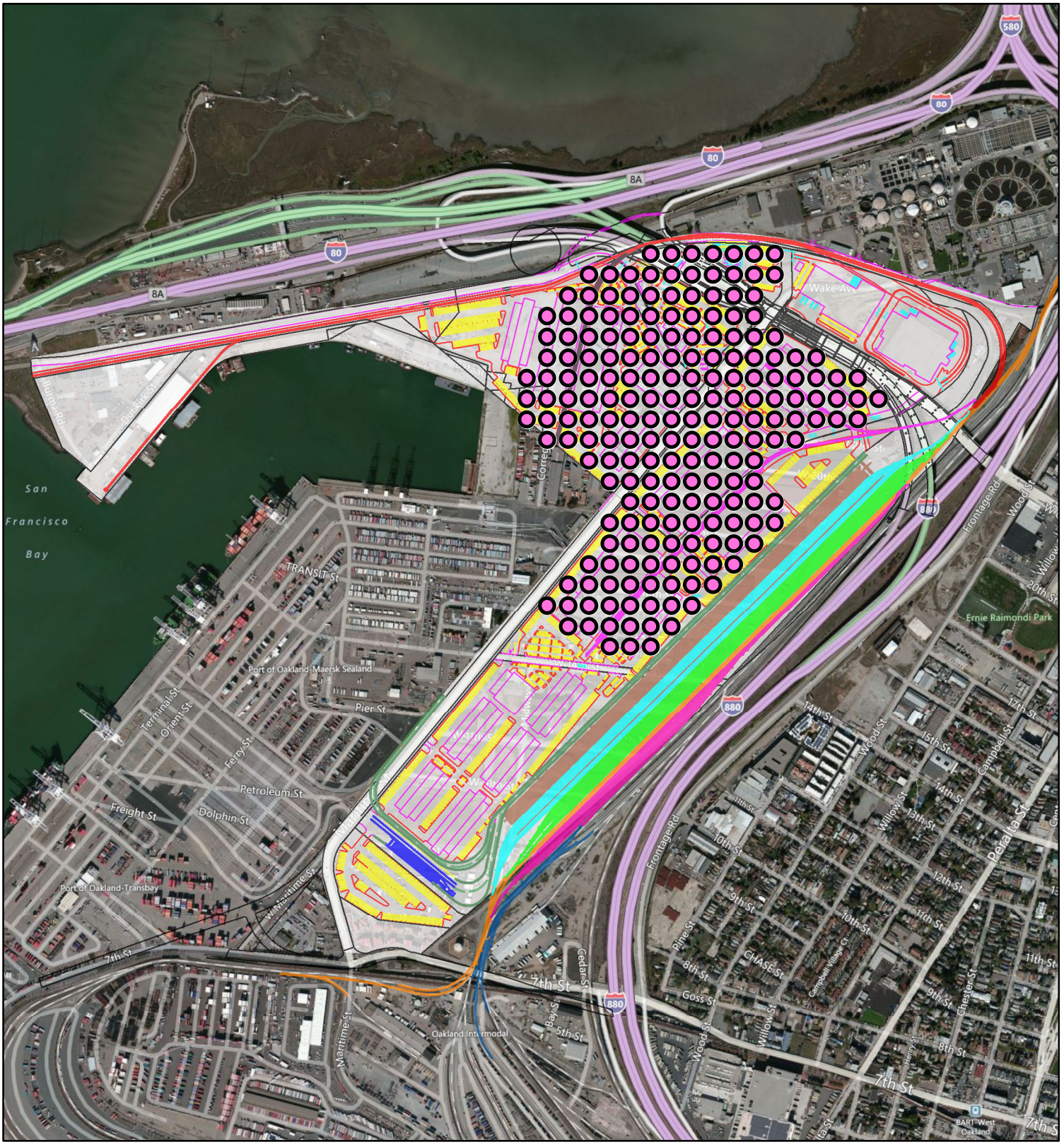
- Offsite Route of Truck Terminals (F14)

N

0 0.125 0.25 0.5 Miles

Figure C.8
Operational Sources
Trucks Terminals Offsite
Oakland Army Base
Oakland, California

ENVIRON



Legend

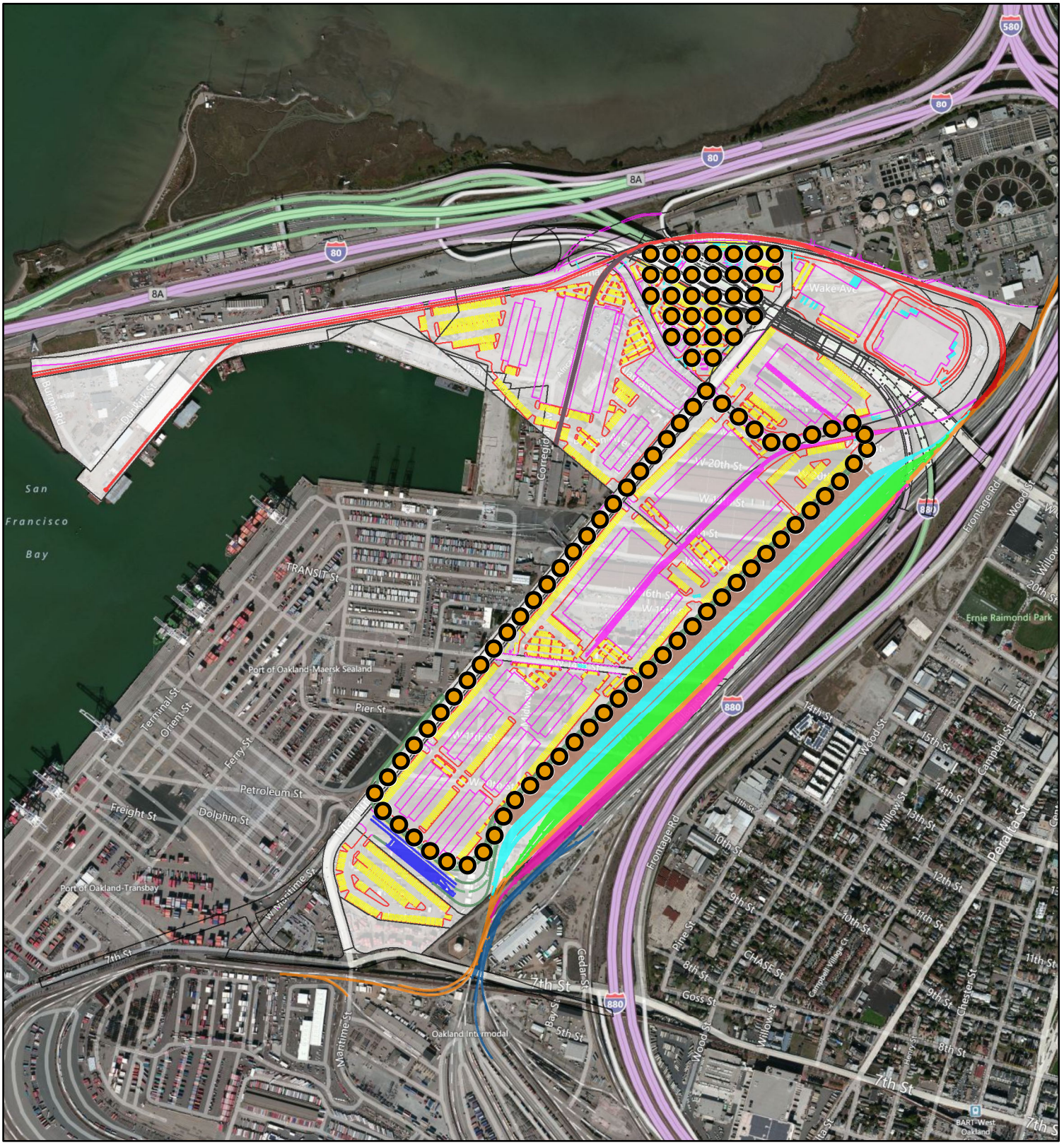
- Onsite Route of Truck Terminals (F14)

N

0 0.125 0.25 0.5 Miles

Figure C.9
Operational Sources
Trucks Terminals Onsite
Oakland Army Base
Oakland, California

ENVIRON



Legend

- OGTIC Portion of Truck Terminals (F14)

N

0 0.125 0.25 0.5 Miles

Figure C.10
Operational Sources
Trucks Terminals OGTIC
Oakland Army Base
Oakland, California

ENVIRON

Legend

- Truck Parking

N

0 0.125 0.25 0.5 Miles

Figure C.11
Operational Sources
Truck Parking Lots
Oakland Army Base
Oakland, California

ENVIRON

Legend

Container Storage Areas (F8, F9, F15)

N

0 0.125 0.25 0.5 Miles

Figure C.12
Operational Sources
Container Storage
Oakland Army Base
Oakland, California

ENVIRON

Legend

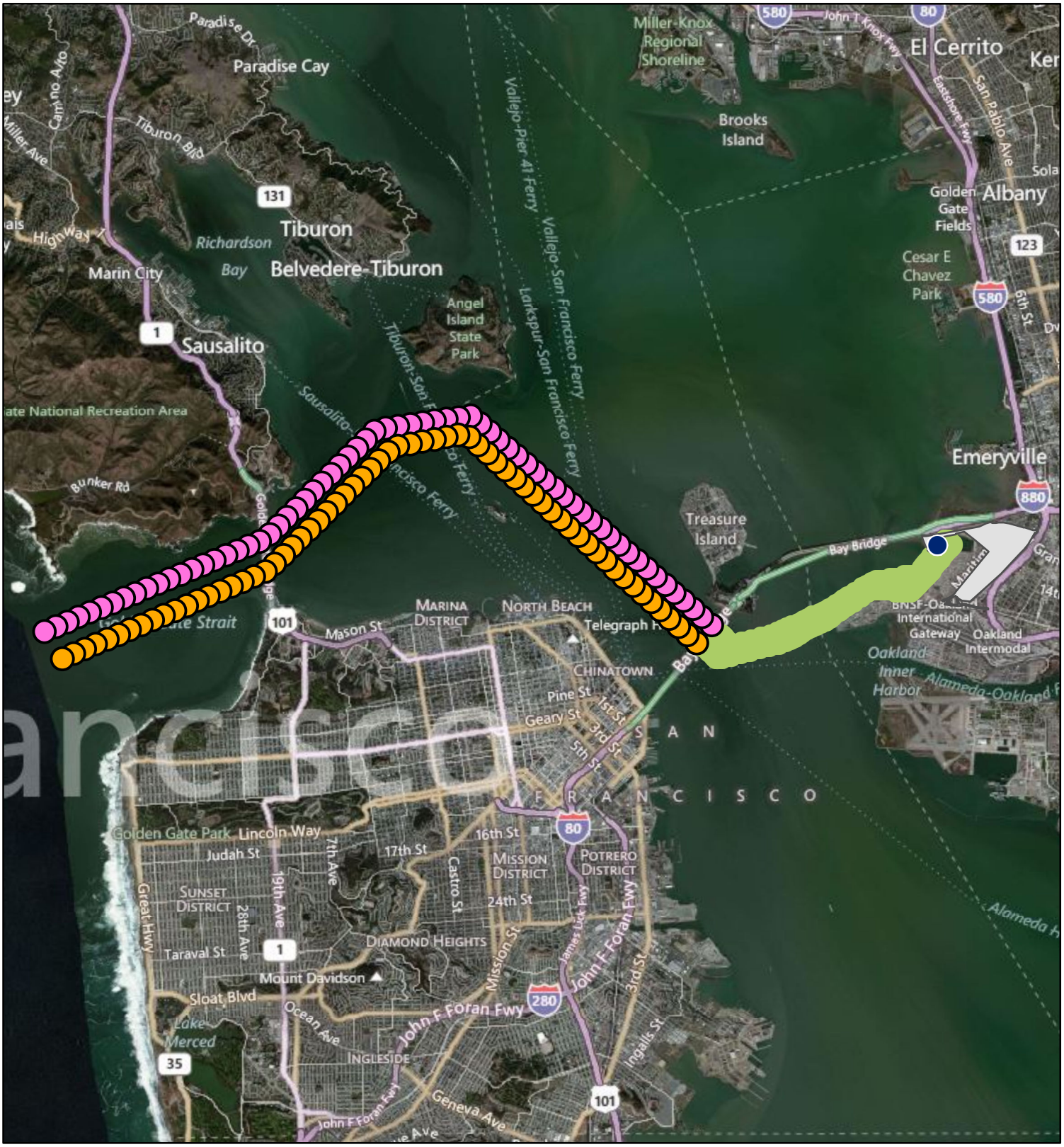
- Grand Avenue Freeway Access
- South Site Freeway Access
- I-880 Truck Route

N

0 0.25 0.5 1 Miles

Figure C.13
Operational Sources
Highway Routes
Oakland Army Base
Oakland, California

ENVIRON



Legend

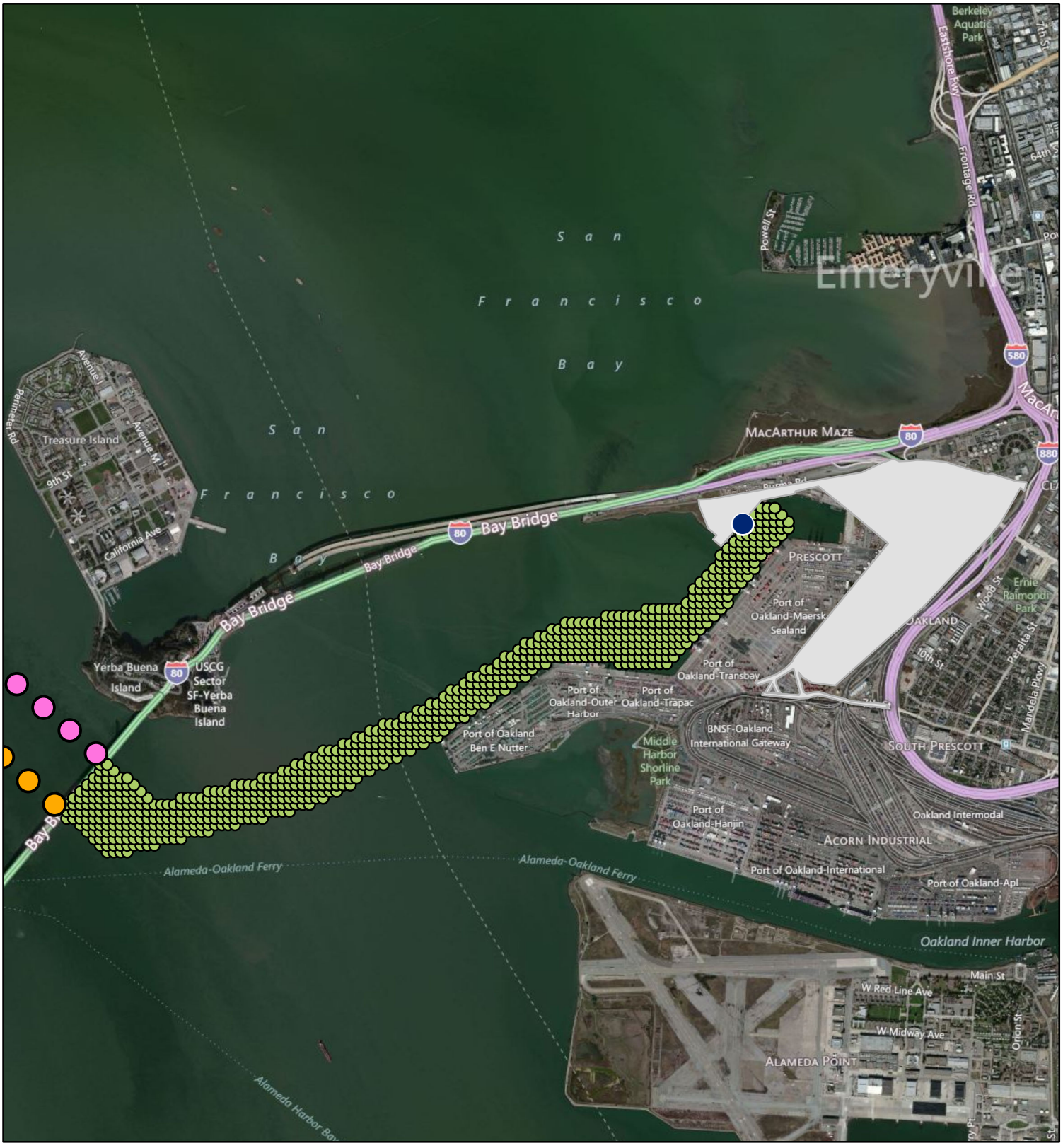
- Inbound Vessel Route
- Outbound Vessel Route
- Vessel Maneuvering
- Hotelling
- Site Location

0 0.5 1 2 Miles

N

Figure C.14
Operational Sources
Vessel Routes
Oakland Army Base
Oakland, California

ENVIRON



Legend

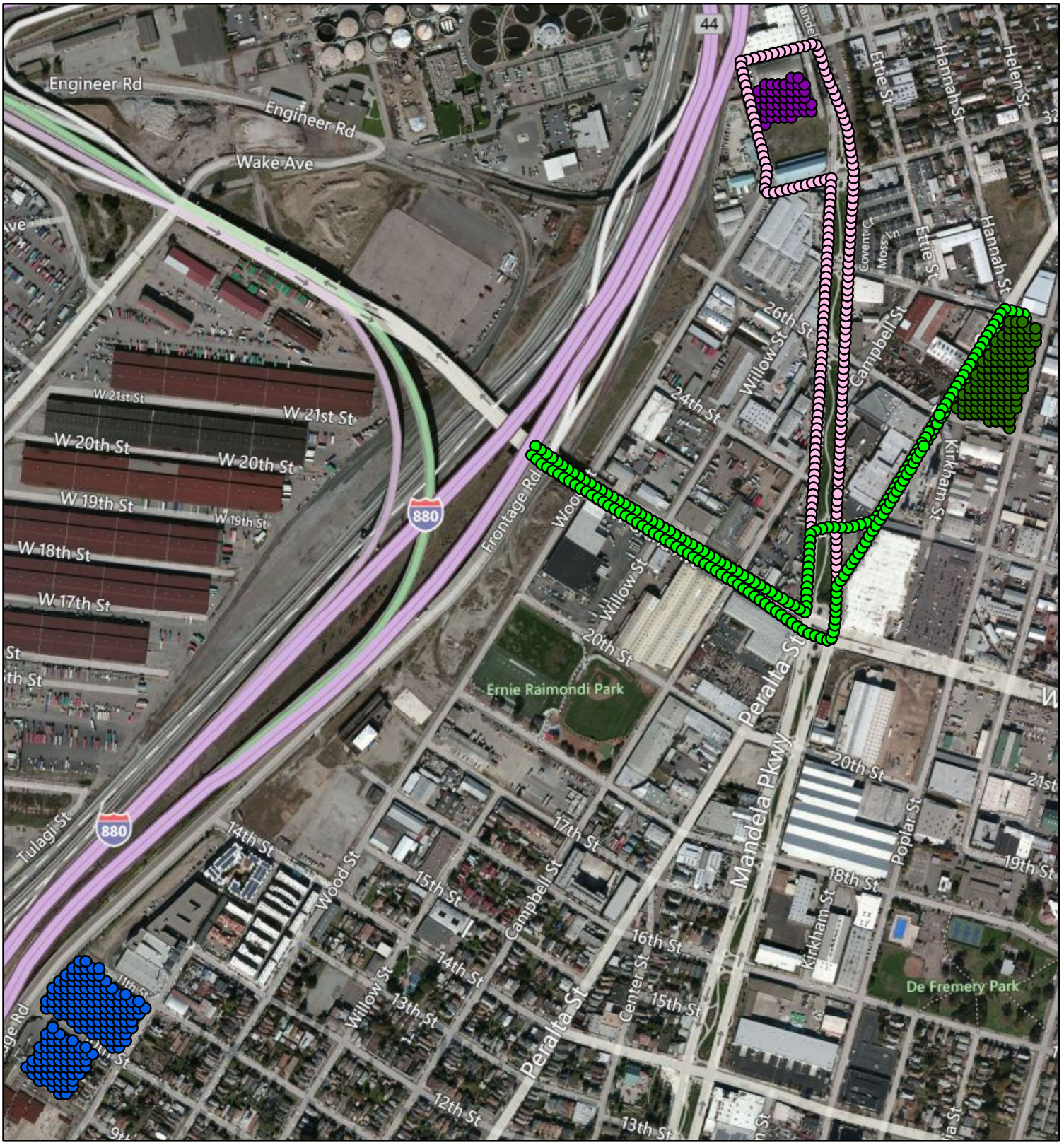
- Inbound Vessel Route
- Outbound Vessel Route
- Vessel Maneuvering
- Hotelling
- Site Location

0 0.375 0.75 1.5 Miles

N

Figure C.15
Operational Sources
Vessels
Oakland Army Base
Oakland, California

ENVIRON



Legend

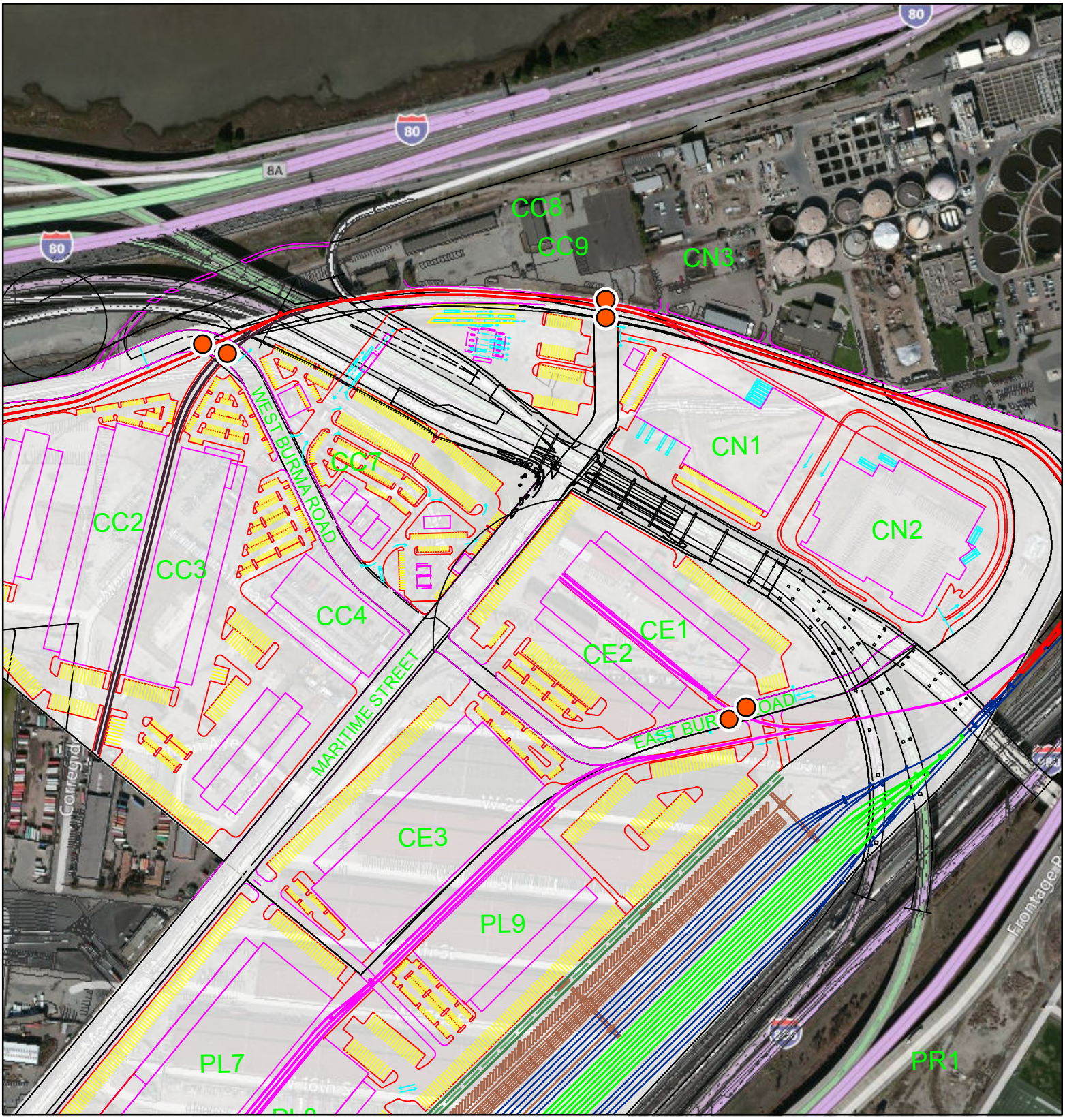
- CWS Facility (South)
- CWS Facility (North)
- CASS Facility
- CWS Truck Route (North)
- CASS Truck Route

N

0 0.05 0.1 0.2 Miles

Figure C.16
Operational Sources
Existing Recycling Centers
Oakland Army Base
Oakland, California

ENVIRON



Legend

- Trucks Idling at Rail ROW

N

0 0.1 0.2 Miles

Figure C.17
Idling Trucks
Oakland Army Base
Oakland, California

ENVIRON