

APPENDIX A: AIR QUALITY CALCULATIONS

Antioch Wharf Replacement Project

NOx Emissions (lbs.)

Month	NOx Emissions (lbs.)				Work Days
	Total	Construction Equipment	Marine Engine	Haul/Worker Vehicle	
July	357.1	72.2	284.3	0.5	5
August	1171.0	426.0	742.4	2.5	21
September	1136.9	439.3	695.0	2.5	21
October	522.5	157.0	363.3	2.2	15
Total	3187.5	1094.6	2085.1	7.8	62
Average Day	51.4				

PM10 Emissions (lbs)

Month	PM10 Emissions (lbs)				Work Days
	Total	Construction Equipment	Marine Engine	Haul/Worker Vehicle	
July	11.8	2.8	9.0	0.0	5
August	43.7	20.1	23.4	0.2	21
September	42.5	20.4	21.9	0.2	21
October	18.6	7.0	11.4	0.1	15
Total	116.5	50.3	65.7	0.5	62
Average Day	1.9				

PM2.5 Emissions (lbs)

Month	PM2.5 Emissions (lbs)				Work Days
	Total	Construction Equipment	Marine Engine	Haul/Worker Vehicle	
July	11.5	2.5	9.0	0.0	5
August	42.7	19.2	23.4	0.1	21
September	41.5	19.5	21.9	0.1	21
October	18.2	6.6	11.4	0.1	15
Total	113.9	47.8	65.7	0.5	62
Average Day	1.8				

ROG Emissions (lbs)

Month	ROG Emissions (lbs)				Work Days
	Total	Construction Equipment	Marine Engine	Haul/Worker Vehicle	
July	50.6	5.2	45.4	0.1	5
August	173.3	54.6	118.5	0.3	21
September	166.0	54.8	110.9	0.3	21
October	75.1	16.9	58.0	0.2	15
Total	465.0	131.5	332.7	0.8	62
Average Day	7.5				

CO2 Emissions (lbs)

Month	CO2 Emissions (lbs)				Work Days
	Total	Construction Equipment	Marine Engine	Haul/Worker Vehicle	
July	34,504	7,281	26,929	294	5
August	120,691	48,823	70,314	1,554	21
September	118,457	51,077	65,826	1,554	21
October	52,011	16,224	34,409	1,378	15
Total	325,663	123,405	197,477	4,781	62
Average Day	5,253				
Total Construction	145.6 metric tons				

Emissions from Commercial Harbor Craft Operating in California

$$E = E_{Fo} \times F \times (1 + D \times (A / UL)) \times HP \times LF \times Hr$$

		E_{Fo}	F	D	A	UL	HP	LF	Hr
	Pollutant	New Engine Factor	Fuel Correction	Deterioration	Engine Age	Engine Life	Horsepower	Load Factor	Hours of Use
		(g/hp_hr)			(yrs)	(yrs)			
Tug Boat	NOx	5.1	0.948	0.21	14	21	425	0.5	6
	PM	0.15	0.8	0.67	14	21	425	0.5	6
	ROG	0.68	1	0.44	14	21	425	0.5	6
	CO	3.73	1	0.25	14	21	425	0.5	6
	CO2	522	1	0	1	1	425	1	6
Dive Boat	NOx	5.32	0.948	0.14	5	17	90	0.45	3
	PM	0.22	0.8	0.44	5	17	90	0.45	3
	ROG	0.99	1	0.28	5	17	90	0.45	3
	CO	3.73	1	0.16	5	17	90	0.45	3
	CO2	490	1	0	1	1	90	1	3

Tug Boat Emission Factors for Use in Antioch Wharf Construction Emission Inventory

		E_{Fo}	F	D	A	UL	HP	LF	Hr
	Pollutant	New Engine Factor	Fuel Correction	Deterioration	Engine Age	Engine Life	Horsepower	Load Factor	Hours of Use
		(g/hp_hr)			(yrs)	(yrs)			
Tug Boat	NOx	5.1	0.948	0.21	14	21	1	1	1
	PM	0.15	0.8	0.67	14	21	1	1	1
	ROG	0.68	1	0.44	14	21	1	1	1
	CO	3.73	1	0.25	14	21	1	1	1
	CO2	522	1	0	1	1	1	1	1

			Ratio
E	E	E (Apdx C)	E
Daily Emissions	Daily Emissions	Daily Emissions	E (Apdx C)
(grams/day)	(lbs/day)	(lbs/day)	
7027.4	15.5	6.2	2.5
221.3	0.5	0.2	2.4
1121.3	2.5	1.0	2.5
5548.4	12.2	4.9	2.5
1331100.0	2934.5	586.5	5.0
638.0	1.4	1.4	1.0
24.2	0.1	0.1	1.0
130.2	0.3	0.3	1.0
474.5	1.0	1.0	1.0
132300.0	291.7	291.7	1.0
E			
Daily Emissions			
(grams/hp_hr)			
5.51			
0.17			
0.88			
4.35			
522.0			

Antioch Wharf (July)							
Pollutant: NOX							
1 Mobilization							
EQUIPMENT	hp	LoadFac*	NOXFac*		Quantity	DURATION	UNIT
Derrick (D-346)	650	0.29	4.31183		1	5	work days
Derrick (D-3406)	465	0.29	6.12404		1	5	work days
Tug Boat	1300	0.5	5.51		1	3	work days
Worker Commute					0	5	work days
							Tot (gram:
							Tot (lbs)
							Tot (lbs/w
							Grand Tot

* Equipment: CalEEMod Appendix D
Truck: EMFAC 2011 HHD Idle 2015

		On- Site		Off-Site				Total	
DURATION	UNIT	DayEmis	TotEmis	Emfac	Length	DayEmis	TotEmis	DayEmis	TotEmis
4.00	hours/day	3251	16256					3251	16256
4.00	hours/day	3303	16517					3303	16517
12.00	hours/day	42991	128973					42991	128973
2	trips/day	0	0	0.5719	12.4	0	0	0	0
s)		49,545	161,745			0	0	49,545	161,745
		109.2	356.6			0.0	0.0	109.2	356.6
	workday)								71.3
total Emissions (grams)			#REF!						

Antioch Wharf (August)							
Pollutant: NOX							
2 Demolition							
EQUIPMENT	hp	LoadFac*	NOXFac*		Quantity	DURATION	UNIT
Derrick (D-346)	650	0.29	4.31183		1	2	work days
Derrick (D-3406)	465	0.29	6.12404		1	2	work days
Generator	50	0.74	4.858		1	2	work days
Chain Saw							
Tug Boat	1300	0.5	5.51		1	2	work days
Worker Commute					10	2	work days
							Tot (gram)
							Tot (lbs)
							Tot (lbs/w)
* Equipment: CalEEMod Appendix D Truck: EMFAC 2011 HHD Idle 2015							
3 Pile Installation							
EQUIPMENT	hp	LoadFac*	NOXFac*		Quantity	DURATION	UNIT
Derrick (D-346)	650	0.29	4.31183		1	10	work days
Derrick (D-3406)	465	0.29	6.12404		1	10	work days
Generator	50	0.74	4.858		1	10	work days
Air compressors	40	0.48	5.223		1	10	work days
Vibratory hammer	1000	0.29	2.29477		1	5	work days
Impact hammer	1000	0.29	2.29477		1	5	work days
Tug Boat	1300	0.5	5.51		1	10	work days
Worker Commute					18	10	work days
							Tot (gram)
							Tot (lbs)
							Tot (lbs/w)
* Equipment: CalEEMod Appendix D Truck: EMFAC 2011 HHD Idle 2015							

4 Head Piece Installation							
EQUIPMENT	hp	LoadFac*	NOXFac*		Quantity	DURATION	UNIT
Derrick (D-346)	650	0.29	4.31183		1	5	work days
Derrick (D-3406)	465	0.29	6.12404		1	5	work days
Generators	50	0.74	4.858		1	5	work days
Air compressors	40	0.48	5.223		1	5	work days
Welding machines	50	0.45	5.113		1	5	work days
Tug Boat	1300	0.5	5.51		1	5	work days
Worker Commute					18	5	work days
							Tot (gram
							Tot (lbs)
							Tot (lbs/w
<p>* Equipment: CalEEMod Appendix D Truck: EMFAC 2011 HHD Idle 2015</p>							

		On- Site		Off-Site				Total	
DURATION	UNIT	DayEmis	TotEmis	Emfac	Length	DayEmis	TotEmis	DayEmis	TotEmis
6.00	hours/day	4877	24383					4877	24383
6.00	hours/day	4955	24775					4955	24775
12.00	hours/day	2157	10785					2157	10785
3.00	hours/day	301	1504					301	1504
16.00	hours/day	1841	9203					1841	9203
6.00	hours/day	21496	107478					21496	107478
2	trips/day	0	0	0.5719	12.4	128	638	128	638
s)		35,626	178,128			128	638	35,753	178,766
		78.5	392.7			0.3	1.4	78.8	394.1
workday)				Truck: EMFAC2011 HHDT 35 mph					78.8
				Worker Commute: EMFAC2011 LDT2 35 mph					

Antioch Wharf (September)

Pollutant: NOX

2 Demolition

EQUIPMENT	hp	LoadFac*	NOXFac*	Quantity	DURATION	UNIT
Derrick (D-346)	650	0.29	4.31183	1	1	work days
Derrick (D-3406)	465	0.29	6.12404	1	1	work days
Generator	50	0.74	4.858	1	1	work days
Chain Saw				1	1	work days
Tug Boat	1300	0.5	5.51	1	1	work days
Worker Commute				10	1	work days

Tot (gram)
Tot (lbs)
Tot (lbs/w)

* Equipment: CalEEMod Appendix D
Truck: EMFAC 2011 HHD Idle 2015

3 Pile Installation

EQUIPMENT	hp	LoadFac*	NOXFac*	Quantity	DURATION	UNIT
Derrick (D-346)	650	0.29	4.31183	1	10	work days
Derrick (D-3406)	465	0.29	6.12404	1	10	work days
Generator	50	0.74	4.858	1	10	work days
Air compressors	40	0.48	5.223	1	8	work days
Vibratory hammer	1000	0.29	2.29477	1	8	work days
Impact hammer	1000	0.29	2.29477	1	8	work days
Tug Boat	1300	0.5	5.51	1	10	work days
Worker Commute				18	10	work days

Tot (gram)
Tot (lbs)
Tot (lbs/w)

* Equipment: CalEEMod Appendix D
Truck: EMFAC 2011 HHD Idle 2015

		On- Site		Off-Site				Total	
DURATION	UNIT	DayEmis	TotEmis	Emfac	Length	DayEmis	TotEmis	DayEmis	TotEmis
4.00	hours/day	3251	3251					3251	3251
4.00	hours/day	3303	3303					3303	3303
8.00	hours/day	1438	1438					1438	1438
8.00	hours/day	0	0					0	0
12.00	hours/day	42991	42991					42991	42991
2	trips/day	0	0	0.5719	12.4	71	71	71	71
s)		50,983	50,983			71	71	51,054	51,054
		112.4	112.4			0.2	0.2	112.6	112.6
workday)				Truck: EMFAC2011 HHDT 35 mph					112.6
				Worker Commute: EMFAC2011 LDT2 35 mph					
		On- Site		Off-Site				Total	
DURATION	UNIT	DayEmis	TotEmis	Emfac	Length	DayEmis	TotEmis	DayEmis	TotEmis
4.00	hours/day	3251	32511					3251	32511
4.00	hours/day	3303	33033					3303	33033
8.00	hours/day	1438	14380					1438	14380
10.00	hours/day	1003	8023					1003	8023
2.50	hours/day	1664	13310					1664	13310
2.50	hours/day	1664	13310					1664	13310
4.00	hours/day	14330	143303					14330	143303
2	trips/day	0	0	0.5719	12.4	128	1276	128	1276
s)		26,653	257,869			128	1,276	26,781	259,146
		58.8	568.5			0.3	2.8	59.0	571.3
workday)				Truck: EMFAC2011 HHDT 35 mph					57.1
				Worker Commute: EMFAC2011 LDT2 35 mph					

4	Head Piece Installation								
	EQUIPMENT	hp	LoadFac*	NOxFac*		Quantity	DURATION	UNIT	
	Derrick (D-346)	650	0.29	4.31183		1	6	work days	
	Derrick (D-3406)	465	0.29	6.12404		1	6	work days	
	Generators	50	0.74	4.858		1	6	work days	
	Air compressors	40	0.48	5.223		1	6	work days	
	Welding machines	50	0.45	5.113		1	6	work days	
	Tug Boat	1300	0.5	5.51		1	6	work days	
	Worker Commute					18	6	work days	
								Tot (gram)	
								Tot (lbs)	
								Tot (lbs/w	
			* Equipment: CalEEMod Appendix D						
			Truck: EMFAC 2011 HHD Idle 2015						

		On- Site		Off-Site				Total	
DURATION	UNIT	DayEmis	TotEmis	Emfac	Length	DayEmis	TotEmis	DayEmis	TotEmis
6.00	hours/day	4877	29260					4877	29260
6.00	hours/day	4955	29730					4955	29730
12.00	hours/day	2157	12942					2157	12942
4.00	hours/day	401	2407					401	2407
12.00	hours/day	1381	8283					1381	8283
6.00	hours/day	21496	128973					21496	128973
2	trips/day	0	0	0.5719	12.4	128	766	128	766
s)		35,266	211,594			128	766	35,393	212,360
		77.7	466.5			0.3	1.7	78.0	468.2
workday)				Truck: EMFAC2011 HHDT 35 mph					78.0
				Worker Commute: EMFAC2011 LDT2 35 mph					

Antioch Wharf (October)

Pollutant: NOX

2 Demolition

EQUIPMENT	hp	LoadFac*	NOXFac*	Quantity	DURATION	UNIT
Derrick (D-346)	650	0.29	4.31183	1	1	work days
Derrick (D-3406)	465	0.29	6.12404	1	1	work days
Generator	50	0.74	4.858	1	1	work days
Chain Saw				1	1	work days
Tug Boat	1300	0.5	5.51	1	1	work days
Worker Commute				10	1	work days

Tot (gram)
Tot (lbs)
Tot (lbs/w

* Equipment: CalEEMod Appendix D
Truck: EMFAC 2011 HHD Idle 2015

5 Walkway & Misc.

EQUIPMENT	hp	LoadFac*	NOXFac*	Quantity	DURATION	UNIT
Derrick (D-346)	650	0.29	4.31183	1	10	work days
Derrick (D-3406)	465	0.29	6.12404	1	10	work days
Generators	50	0.74	4.858	1	10	work days
Air compressors	40	0.48	5.223	1	10	work days
Welding machines	50	0.45	5.113	1	10	work days
Tug Boat	1300	0.5	5.51	1	10	work days
Worker Commute				10	10	work days

Tot (gram)
Tot (lbs)
Tot (lbs/w

* Equipment: CalEEMod Appendix D
Truck: EMFAC 2011 HHD Idle 2015

6 Demobilization

EQUIPMENT	hp	LoadFac*	NOXFac*	Quantity	DURATION	UNIT
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		On- Site		Off-Site				Total	
DURATION	UNIT	DayEmis	TotEmis	Emfac	Length	DayEmis	TotEmis	DayEmis	TotEmis
4.00	hours/day	3251	3251					3251	3251
4.00	hours/day	3303	3303					3303	3303
8.00	hours/day	1438	1438					1438	1438
8.00	hours/day	0	0					0	0
12.00	hours/day	42991	42991					42991	42991
2	trips/day	0	0	0.5719	12.4	71	71	71	71
s)		50,983	50,983			71	71	51,054	51,054
		112.4	112.4			0.2	0.2	112.6	112.6
workday)				Truck: EMFAC2011 HHDT 35 mph					112.6
				Worker Commute: EMFAC2011 LDT2 35 mph					
		On- Site		Off-Site				Total	
DURATION	UNIT	DayEmis	TotEmis	Emfac	Length	DayEmis	TotEmis	DayEmis	TotEmis
2.00	hours/day	1626	16256					1626	16256
2.00	hours/day	1652	16517					1652	16517
4.00	hours/day	719	7190					719	7190
1.00	hours/day	100	1003					100	1003
1.00	hours/day	115	1150					115	1150
1.00	hours/day	3583	35826					3583	35826
2	trips/day	0	0	0.5719	12.4	71	709	71	709
s)		7,794	77,941			71	709	7,865	78,650
		17.2	171.8			0.2	1.6	17.3	173.4
workday)				Truck: EMFAC2011 HHDT 35 mph					17.3
				Worker Commute: EMFAC2011 LDT2 35 mph					
		On- Site		Off-Site				Total	
DURATION	UNIT	DayEmis	TotEmis	Emfac	Length	DayEmis	TotEmis	DayEmis	TotEmis

Derrick (D-346)	650	0.29	4.31183		1	2	work days
Derrick (D-3406)	465	0.29	6.12404		1	2	work days
Tug Boat	1300	0.5	5.51		1	1	work days
Worker Commute					0	2	work days
							Tot (gram)
							Tot (lbs)
							Tot (lbs/w
			* Equipment: CalEEMod Appendix D				
			Truck: EMFAC 2011 HHD Idle 2015				

4.00	hours/day	3251	6502					3251	6502
4.00	hours/day	3303	6607					3303	6607
12.00	hours/day	42991	42991					42991	42991
2	trips/day	0	0	0.5719	12.4	0	0	0	0
s)		49,545	56,100			0	0	49,545	56,100
		109.2	123.7			0.0	0.0	109.2	123.7
workday)				Truck: EMFAC2011 HHDT 35 mph					61.8
				Worker Commute: EMFAC2011 LDT2 35 mph					