

Appendix K

Calculated Estimates of Air Quality Emissions

This appendix includes the calculation spreadsheets used to estimate air quality emissions and supports the analysis included in Section 3.6, “Air Quality,” of the Draft EIS/EIR. The calculation spreadsheets are organized as follows.

- Table K-1. Hydraulic Offloading Operations Emissions
- Table K-2. Mechanical Unloading and Daily Operations Emissions Estimates
- Table K-3 Tug Horse Power Required for Different Scow Sizes.

Table K-1. Hydraulic Offloading Operations Emissions

Hydraulic Offloading Operations Daily Emissions (ppd)					
	Nox	ROG	PM10	CO	
2500 hp Engine	185.2	10.5	7.7	135.0	
500 Hp Engine	37.0	2.1	1.5	27.0	
Tug Emissions	118.0	5.7	2.9	15.9	
Total Daily Emissions	340.2	18.3	12.2	178.0	

Hydraulic Offloading Operations Annual Emissions (tons/year)					
	Nox	ROG	PM10	CO	
2500 hp Engine	17.4	1.0	0.7	12.7	
500 Hp Engine	3.5	0.2	0.1	2.5	
Tug Emissions	11.1	0.5	0.3	1.5	
Total Annual Emissions	32.0	1.7	1.1	16.7	

Note: This table is based on information included in the following spreadsheets K-1a, K-1b, and K-1c (on the following pages) and on Table K-3.

Spreadsheet K-1a. Hydraulic Offloading - 2500 Engine Horsepower Rating

Existing Engine Requirements	2005 Engine Requirements Nox
7.2 Emission Factor (g/bhp-hr.)	4.8 Emission Factor (g/bhp-hr.)
453.59 g/lb	453.59 g/lb
2500 hp	2500 hp
10 Hours of Operation	10 Hours of Operation
0.7 load Factor	0.7 load Factor
277.7839 lbs/day	185.1893 lbs/day
188 days of operation	188 days of operation
26.11169 tons per year	17.40779 tons per year

CO	CO-New Requirements
0.0055 Emission Factor (lb/bhp-hr.)	3.5 Emission Factor (g/bhp-hr.)
2500 hp	453.59 g/lb
10 Hours of Operation	2500 hp
0.7 load Factor	10 Hours of Operation
96.25 Pounds per day	0.7 load Factor
188 days of operation	135.0338 lbs/day
9.0475 tons per year	188 days of operation
	12.69318 tons per year

PM	PM New Requirements
0.0007 Emission Factor (lb/bhp-hr.)	0.2 Emission Factor (g/bhp-hr.)
2500 hp	453.59 g/lb
10 Hours of Operation	2500 hp
0.7 load Factor	10 Hours of Operation
12.25 Pounds per day	0.7 load Factor
188 days of operation	7.716219 lbs/day
1.1515 tons per year	188 days of operation
	0.725325 tons per year

ROG

0.0006 Emission Factor (lb/bhp-hr.)
 2500 hp
 10 Hours of Operation
 0.7 load Factor
 10.5 Pounds per day

 188 days of operation
 0.987 tons per year

Spreadsheet K-1b. Hydraulic Offloading - 500 Horsepower Auxillary Engine

Existing Engine Requirements	2005 Engine Requirements Nox
7.2 Emission Factor (g/bhp-hr.)	4.8 Emission Factor (g/bhp-hr.)
453.59 g/lb	453.59 g/lb
500 hp	500 hp
10 Hours of Operation	10 Hours of Operation
0.7 load Factor	0.7 load Factor
55.55678 lbs/day	37.03785 lbs/day
188 days of operation	188 days of operation
5.222337 tons per year	3.481558 tons per year

CO	CO-New Requirements
0.0055 Emission Factor (lb/bhp-hr.)	3.5 Emission Factor (g/bhp-hr.)
500 hp	453.59 g/lb
10 Hours of Operation	500 hp
0.7 load Factor	10 Hours of Operation
19.25 Pounds per day	0.7 load Factor
188 days of operation	27.00677 lbs/day
1.8095 tons per year	188 days of operation
	2.538636 tons per year

PM	PM New Requirements
0.0007 Emission Factor (lb/bhp-hr.)	0.2 Emission Factor (g/bhp-hr.)
500 hp	453.59 g/lb
10 Hours of Operation	500 hp
0.7 load Factor	10 Hours of Operation
2.45 Pounds per day	0.7 load Factor
188 days of operation	1.543244 lbs/day
0.2303 tons per year	188 days of operation
	0.145065 tons per year

ROG

0.0006 Emission Factor (lb/bhp-hr.)
 500 hp
 10 Hours of Operation
 0.7 load Factor
 2.1 Pounds per day
 188 days of operation
 0.1974 tons per year

Spreadsheet K-1c. Hydraulic Offloading - Tugboat Emissions Calculations

Operations Data		
Engine Size (hp)	2750	(Average Hp rating of class) Based on data collected from Dredging Contractors
Engine Size (kW)	2051	
Arrival Maneuvering Fractional Load	0.75	
Arrival Maneuvering Load (kW)	1538	
Arrival Maneuvering (hr/call)	0.75	
Number of tugs during Arrival	1	
Departure Maneuvering Fractional Load	0.5	
Departure Maneuvering Load (KW)	1025	
Departure Maneuvering (hr/call)	0.5	
Number of Tugs During Departure	1	

Estimated Barge Calls per day 3

Pollutant Data	Exponent (x)	Intercept (b)	Coefficient	Emission Rate(g/kW-hr)	
				Arrival	Departure
PM10	1.5	0.2551	0.0059	0.26	0.27
Nox	1.5	10.4496	0.1255	10.64	10.80
CO	1	0.1548	0.8378	1.27	1.83
ROG	1.5	0.3859	0.0667	0.49	0.57

Where emission rate (g/kW-hr) = a(Fractional Load)^x +b

Source: U.S. EPA *Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data* (February 2000).

	Total Tug Operating Emissions (pounds)			Total Per Day	Tons per year	
	Arrival	Departure	Total Per Barge			
PM10		0.7	0.3	1.0	2.9	0.276
Nox		27.1	12.2	39.3	118.0	11.091
CO		3.2	2.1	5.3	15.9	1.497
ROG		1.2	0.7	1.9	5.7	0.534

Where Emissions=Emission rate(g/kW-hr)*Mode Specific(kW)*Time

Table K-2. Mechanical Unloading and Daily Operations Emissions Estimates

Fugitive PM10

Acres graded, excavated/moved each day	==>	5
Acres graded, excavated/moved days/year	==>	50

Construction Vehicle Exhaust Emissions

Equipment Type	Number of Vehicles	Hours per Day	No. of days	Default Values Horsepower	Default Values Load Factor	Emission Rate (gm/bhp-hr)			
						ROG	CO	NOx	PM10
Cranes	==> 1	24	50	365	0.43	1.44	12.27	8.90	0.35
Dozers	==> 1	12	50	174	0.575	1.76	14.98	11.00	0.45

Haul Truck Emissions

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	
Miles/round trip	==> 1.5	0	0	0	0	0
Round trips/day	==> 25	0	0	0	0	0
Number of Trucks	==> 8	0	0	0	0	0
Number of Days	==> 50	0	0	0	0	0
	ROG	CO	NOx	PM10		
Truck EMFAC2002 EF (pounds/mile)	0.002779	0.019135	0.026756	0.000887		

Worker Commute Emissions

Miles/trip	==>	30		
trips/day	==>	4		
Number of Light Duty Trucks	==>	0		
Number of Days	==>	50		
	ROG	CO	NOx	PM10
Worker Cars EMFAC2002 EF (pounds/mile)	0.001497	0.013925	0.001489	0.000114

Mechanical Offloading Operations Daily Emissions (ppd)				
Emission Source	Emissions (ppd)			
	ROG	CO	NOx	PM10
Construction Vehicle Exhaust Emissions	16.6	141.5	103.0	4.1
Fugitive PM10				50.0
Haul Truck Emissions	0.8	5.7	8.0	0.3
Worker Commute Emissions	0.0	0.0	0.0	0.0
Tug Emissions	3.4	9.4	69.9	1.7
Total Emissions (ppd)	20.8	156.7	181.0	56.1

Mechanical Offloading Operations Annual Emissions (tons/year)				
Emission Source	Emissions (tpy)			
	ROG	CO	NOx	PM10
Construction Vehicle Exhaust Emissions	0.4	3.5	2.6	0.1
Fugitive PM10				1.3
Haul Truck Emissions	0.0	0.1	0.2	0.0
Worker Commute Emissions	0.0	0.0	0.0	0.0
Tug Emissions	0.1	0.2	1.7	0.0
Total Emissions (tpy)	0.5	3.9	2.8	1.4

Note: This table is based on information included in spreadsheets K-2a and K-2b (on the following pages) and on Table K-3.

Spreadsheet K-2a. Estimated Construction-Related Emissions

Fugitive PM10

Acres graded, excavated/moved each day ==> 5
 Acres graded, excavated/moved days/year ==> 50

Construction Vehicle Exhaust Emissions

Equipment Type	Number of Vehicles	Hours per Day	No. of days	Default Values Horsepower	Default Values Load Factor	Emission Rate (gm/bhp-hr)			
						ROG	CO	NOx	PM10
Cranes	1	24	50	190	0.43	1.44	12.27	8.37	0.23
Dozer	1	12	50	174	0.575	1.76	14.98	10.42	0.32

Haul Truck Emissions

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5
Miles/round trip	1.5	0	0	0	0
Round trips/day	25	0	0	0	0
Number of Trucks	8	0	0	0	0
Number of Days	50	0	0	0	0

	ROG	CO	NOx	PM10
Truck EMFAC2002 EF (pounds/mile)	0.002295	0.01454	0.021501	0.000719

Worker Commute Emissions

Miles/trip ==> 30
 trips/day ==> 4
 Number of Light Duty Trucks ==> 0
 Number of Days ==> 50

	ROG	CO	NOx	PM10
Worker Cars EMFAC2002 EF (pounds/mile)	0.001179	0.010849	0.001138	0.000116

Emission Source	Emissions (ppd)			
	ROG	CO	NOx	PM10
Construction Vehicle Exhaust Emissions	10.9	92.8	63.8	1.8
Fugitive PM10				50.0
Haul Truck Emissions	0.7	4.4	6.5	0.2
Worker Commute Emissions	0.0	0.0	0.0	0.0
Total Emissions (ppd)	11.6	97.2	70.3	52.1

Emission Source	Emissions (tpy)			
	ROG	CO	NOx	PM10
Construction Vehicle Exhaust Emissions	0.3	2.3	1.6	0.0
Fugitive PM10				1.3
Haul Truck Emissions	0.0	0.1	0.2	0.0
Worker Commute Emissions	0.0	0.0	0.0	0.0
Total Emissions (tpy)	0.3	2.4	1.8	1.3

Spreadsheet K-2b. Tugboat Emissions Calculations

Operations Data	
Engine Size (hp)	1630
Engine Size (kW)	1215
Arrival Maneuvering Fractional Load	0.75
Arrival Maneuvering Load (kW)	912
Arrival Maneuvering (hr/call)	0.75
Number of tugs during Arrival	1
Departure Maneuvering Fractional Load	0.5
Departure Maneuvering Load (KW)	608
Departure Maneuvering (hr/call)	0.5
Number of Tugs During Departure	1

Estimated Barge Calls per day 3

Pollutant Data	Exponent (x)	Intercept (b)	Coefficient (a)	Emission Rate(g/kW-hr)	
				Arrival	Departure
PM10	1.5	0.2551	0.0059	0.26	0.27
Nox	1.5	10.4496	0.1255	10.64	10.80
CO	1	0.1548	0.8378	1.27	1.83
ROG	1.5	0.3859	0.0667	0.49	0.57

Where emission rate (g/kW-hr) = a(Fractional Load)^x +b

Source: U.S. EPA *Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data* (February 2000).

	Total Tug Operating Emissions (pounds)			
	Arrival	Departure	Total Per Barge	Total Per Day
PM10	0.4	0.2	0.6	1.7
Nox	16.1	7.2	23.3	69.9
CO	1.9	1.2	3.1	9.4
ROG	0.7	0.4	1.1	3.4

Where Emissions=Emission rate(g/kW-hr)*Mode Specific(kW)*Time

Table K-3. Tug horse power required to navigate different scow sizes

Quote Source - May 26, 2005	Mechanical off-loading at Pier 34		Hydraulic Off-loading near Pier 35
	1000 CY	3000 CY	5000 CY
Mark Reid - Great Lakes Dredge & Dock	1800	1800	3000
Jim Galli - Marine Services of Vallejo (dredging consultant)	1000	1600	2200
Bill Partridge - Manson Construction	1000	1500	2000
Westar Marine Services (Mr. Sherfy)	1000 - 1200	1500 - 2000	3000
Mark Guin - Brusco Tug	900	1500	3000
Frank Bryant - Gahagan & Bryant Associates (dredging consultant)	1000		3000
Average	1133 HP	1630 HP	2750 HP

Note: additional 300HP tug needed for 5000CY barge