

Appendix B
Greenhouse Gas Emission Estimates

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HERCULES LLC/PROLOGIS AIR EMISSION AND GHG EMISSION ESTIMATE

BACKGROUND DATA						
Work Period						
Construction Period (calendar days)	15					
Construction Period (weeks)	3					
No. of crew/day	10					
No. of hours/day	10					
Soil Disturbance	Area		Assumptions/Notes			
	100	sq ft	Riprap removal			
	200	sq ft	Uncover pipeline for grouting			
	Soil condition: primarily wet or moist due to shoreline location					
Equipment Use	No.	Hours/ Day	No. of Days	Load Factor	hp	Assumptions/Notes
Tug/tending	1	10	15	0.1	950	Mostly idle; 1 hr active work
Tug/towing	1	5	3	0.9	950	Assumes 1 RT for onshore barge; 2 RTs for pipeline removal barge; assumes barge is located in Alameda; 21 nm one-way @ 8 - 9 knots
Crew Boat	1	3	15	0.8	635	
Air Compressor	1	10	15	0.4	48	
Welding Machine	1	10	1	0.4	49	
Work Skiff (gasoline)	1	8	15	0.4	50	
Crane	1	10	4	0.3	185	Used to remove and replace riprap; would also move gangway; less than 1 hour/day during onshore work period when not moving riprap
Derrick	1	10	10	0.4	320	Work Skiff

Note: All equipment is diesel-fueled unless otherwise noted

On-Road Vehicles	No. of Vehicles	Daily Mileage/ Vehicle	No. of Days	Total Miles	Basis	Assumptions and Notes
Crew Commute Vehicles	10	60	15	9,000	30 mi. one-way	Worst case, each crew member drives his/her own vehicle; assume average 60 mi. RT commute, average vehicle age = 5 years, equal mix of gasoline cars, gasoline pick-ups/SUVs, diesel pick-ups/SUVs
Off-haul Trucks	1	60	5	300	25 mi. one-way	
Misc. Construction Support	1	50	15	750	30 mi. one-way	Pick-up Truck

EMISSION FACTORS

Construction Equipment Emission Factors	No.	g CO2/hp-hr	gCH4/hp-hr	gN2O/hp-hr
Tug/tending	1	864.6	0.12	0.009
Tug/towing (assume 3 RTs)	1	864.6	0.12	0.009
Crew Boat	1	864.6	0.12	0.009
			g CH4/gal	gN2O/gal
Air Compressor	1	273	0.58	0.26
Welding Machine	1	256	0.58	0.26
Work Skiff (gasoline)	1	780.7	0.64	0.22
Crane	1	244.6	0.58	0.26
Derrick	1	244.6	0.58	0.26

<i>Brake-Specific Fuel Consumption for Off-Road Equipment</i>	
Engine hp	BSFC (lb/hp-hr)
26 - 50	0.54
51 - 121	0.49
121-175	0.47
176-250	0.47

Sources for Emission Factors:
 CH2M HILL. 2008. Container Terminal Project. April (Appendix E1.3; p. E1.3-13)
 2012 Climate Registry Default Emission Factors, Released January 6, 2012
 URBEMIS2007 for Windows Users' Guide, Version 9.2; Appendix I - Construction Equipment Emission Factors, P. I-41

<i>Average emission factor for crew personal vehicles</i>			
Gasoline cars	Year	Methane	Nitrous Oxide
		g/mi.	g/mi.
	2003	0.0114	0.0135
	2004	0.0145	0.0083
	2005	0.0147	0.0079
	2006	0.0161	0.0057
	2007	0.0170	0.0041
	2008	0.0172	0.0038
	2009	0.0173	0.0036
	2010	0.0173	0.0036
	2011	0.0173	0.0036
	2012	0.0173	0.0036
Average		0.01601	0.00577
Gasoline Pickup/SUVs	2003	0.0155	0.0114
	2004	0.0152	0.0132
	2005	0.0157	0.0101
	2006	0.0159	0.0089
	2007	0.0161	0.0079
	2008	0.0163	0.0066
	2009	0.0163	0.0066
	2010	0.0163	0.0066
	2011	0.0163	0.0066
	2012	0.0163	0.0066
Average		0.01599	0.00845
Diesel Pickup/SUVs	1996-present	0.0010	0.0015
Average for personal vehicles		0.0110	0.0052

Assumes 1/3 each gasoline cars, gasoline pick-ups, and diesel pick-ups/SUVs

Source: 2012 Climate Registry Default Emission Factors; Released January 6, 2012

Summary of Vehicle Emission Factors	"Average" Crew Commute Vehicle	Large Passenger Van (Gasoline)	Diesel Pick-up (Moderate)	Med.- or Heavy-Duty Truck	Ag Equip. (diesel)	Misc. Constr. Equipment (diesel)
		g/mi.	g/mi.	g/mi.	g/gal	g/gal
Methane	0.0110	0.1516	0.0009	0.0051	1.44	0.58
Nitrous Oxide	0.0052	0.0639	0.0014	0.0048	0.26	0.26

Source: 2012 Climate Registry Default Emission Factors; Released January 6, 2012

GENERAL ASSUMPTIONS AND CALCULATION FACTORS

1 gal =	0.264	liters
	4.45	lbs/hr. fuel consumption of misc. small gasoline-fueled constr. equipment (50 hp) at full load
8780	g CO ₂ /gal motor gasoline	
39,035	gCO ₂ /hr	
780.7	gCO ₂ /hp-hr	
6.073	gasoline density lbs/gal	
	Source: Wikipedia	
7.09	density of diesel fuel; lbs/gal	
	Source: http://enxsa.com/diesel.html	

Global Warning Potential Relative to CO₂

Methane	21
Nitrous Oxide	310
Source: US EPA	

Fuel Consumption Estimate

Type	mi/gal	kgCO ₂ / gal fuel	gCO ₂ / mi	Source
Personal Vehicles	24.1	8.78	364.3	
Pick-up Truck	17.3	10.21	590.2	
Off-Haul Trucks	7.3	10.21	1,398.6	

Sources:

Personal Vehicles: www.epa.gov/otaq/consumer/420f08024.pdf

Pick-up Trucks: www.epa.gov/otaq/consumer/420f08024.pdf

Off-Haul Trucks: http://cta.ornl.gov/vtmarketreport/pdf/chapter3_heavy_trucks.pdf

CALCULATION OF CONSTRUCTION EMISSIONS

Criteria Air Pollutants

Not required: Minimal construction during, minor project; BAAQMD BMPs apply

GHG Emissions

Vehicle Emissions	Total CO2		Total Methane		Total Nitrous Oxide		MT CO2e CH4 and N2O	TOTAL CO2e (MT)
	g	MT	g	MT	g	MT		
Crew Commute Vehicles	3,278,838	3.28	99	9.90E-05	47.16	4.72E-05	0.02	3.3
Off-haul Trucks	177,052	0.18	1.53	1.53E-06	1.44	1.44E-06	0.00	0.2
Misc. Construction Support (Pick-up Truck)	1,048,973	1.05	0.68	6.75E-07	1.05	1.05E-06	0.00	1.0
TOTAL ON-ROAD VEHICLE USE								4.5

Construction Equipment Emissions	Calculated fuel consumption (gal)	MT CO2	MT CO2e from CH4 and N2O	TOTAL CO2e
Global warming potential factor				
Tug/tending		12.32	0.073	12.4
Tug/towing (assume 3 RTs)		11.09	0.066	11.2
Crew Boat		19.77	0.118	19.9
Air Compressor	219.4	0.79	0.020	0.8
Welding Machine	14.9	0.05	0.001	0.1
Work Skiff (gasoline)	213.4	1.87	0.017	1.9
Crane	84.5	0.27	0.008	0.6
Derrick	974.9	3.13	0.090	3.2
TOTAL CONSTRUCTION EQUIPMENT				50.0

TOTAL CONSTRUCTION EQUIPMENT PLUS VEHICLE USE CO2e (MT) 54.5

CALCULATION OF OPERATING EMISSIONS

None: construction project only

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