APPENDIX A
Air Quality Supporting Documentation

Construction

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Tasks

Tasks, Durations, and Construction Emissions by Task

ID	Task Name	Duration (days)	Approx. Start Date	Approx. End Date	Max. Daily Construction Emissions (lb/day)						
					NOx	VOC	CO	PM10	PM2.5	SO2	GHG
1	**DRAFT Pier 400 Project Construction Schedule**										
2	Mobilization	1	4/1/2020	4/2/2020	2.6	0.2	2.3	0.4	0.2	0.0	1,467
3	Site Removals	60	4/2/2020	6/1/2020	24.6	1.1	9.9	9.7	1.7	0.1	10,843
4	Abutment #1 Excavation	7	6/1/2020	6/8/2020	4.4	0.3	5.1	0.6	0.3	0.0	2,281
5	Abutment #1 Pile Driving	3	6/8/2020	6/11/2020	18.6	1.9	9.8	1.3	1.0	0.0	3,686
6	Abutment #1 Final Construction	7	6/11/2020	6/18/2020	41.9	1.1	5.7	2.3	1.5	0.2	16,288
7	Bent #1 Pile Driving	2	6/18/2020	6/20/2020	18.6	1.9	9.8	1.3	1.0	0.0	3,686
8	Bent #1 Pile Cap Forming	7	6/20/2020	6/27/2020	3.3	0.4	8.1	0.4	0.3	0.0	1,969
9	Bent #1 Pile Cap Pour & Curing	7	6/27/2020	7/4/2020	5.6	0.2	1.9	0.6	0.3	0.0	2,604
10	Bent #1 Pile Cap Forming Removal	7	7/4/2020	7/11/2020	1.6	0.3	3.9	0.4	0.2	0.0	1,248
11	Girder Set #1 Placement	7	7/11/2020	7/18/2020	2.5	0.3	4.0	0.4	0.3	0.0	1,529
12	Bent #2 Pile Driving	2	7/18/2020	7/20/2020	18.6	1.9	9.8	1.3	1.0	0.0	3,686
13	Bent #2 Pile Cap Forming	7	7/20/2020	7/27/2020	3.3	0.4	8.1	0.4	0.3	0.0	1,969
14	Bent #2 Pile Cap Pour & Curing	7	7/27/2020	8/3/2020	5.6	0.2	1.9	0.6	0.3	0.0	2,604
15	Bent #2 Pile Cap Forming Removal	7	8/3/2020	8/10/2020	1.6	0.3	3.9	0.4	0.2	0.0	1,248
16	Girder Set #2 Placement	7	8/10/2020	8/17/2020	2.5	0.3	4.0	0.4	0.3	0.0	1,529
17	Bent #3 Pile Driving	2	8/17/2020	8/19/2020	18.6	1.9	9.8	1.3	1.0	0.0	3,686
18	Bent #3 Pile Cap Forming	7	8/19/2020	8/26/2020	3.3	0.4	8.1	0.4	0.3	0.0	1,969
19	Bent #3 Pile Cap Pour & Curing	7	8/26/2020	9/2/2020	5.6	0.2	1.9	0.6	0.3	0.0	2,604
20	Bent #3 Pile Cap Forming Removal	7	9/2/2020	9/9/2020	1.6	0.3	3.9	0.4	0.2	0.0	1,248
21	Girder Set #3 Placement	7	9/9/2020	9/16/2020	2.5	0.3	4.0	0.4	0.3	0.0	1,529
22	Bent #4 Pile Driving	2	9/16/2020	9/18/2020	18.6	1.9	9.8	1.3	1.0	0.0	3,686
23	Bent #4 Pile Cap Forming	7	9/18/2020	9/25/2020	3.3	0.4	8.1	0.4	0.3	0.0	1,969
24	Bent #4 Pile Cap Pour & Curing	7	9/25/2020	10/2/2020	5.6	0.2	1.9	0.6	0.3	0.0	2,604
25	Bent #4 Pile Cap Forming Removal	7	10/2/2020	10/9/2020	1.6	0.3	3.9	0.4	0.2	0.0	1,248
26	Girder Set #4 Placement	7	10/9/2020	10/16/2020	2.5	0.3	4.0	0.4	0.3	0.0	1,529
27	Bent #5 Pile Driving	2	10/16/2020	10/18/2020	18.6	1.9	9.8	1.3	1.0	0.0	3,686

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Tasks

Tasks, Durations, and Construction Emissions by Task

ID	Task Name	Duration (days)	Approx. Start Date	Approx. End Date	Max. Daily Construction Emissions (lb/day)						
					NOx	VOC	CO	PM10	PM2.5	SO2	GHG
28	Bent #5 Pile Cap Forming	7	10/18/2020	10/25/2020	3.3	0.4	8.1	0.4	0.3	0.0	1,969
29	Bent #5 Pile Cap Pour & Curing	7	10/25/2020	11/1/2020	5.6	0.2	1.9	0.6	0.3	0.0	2,604
30	Bent #5 Pile Cap Forming Removal	7	11/1/2020	11/8/2020	1.6	0.3	3.9	0.4	0.2	0.0	1,248
31	Girder Set #5 Placement	7	11/8/2020	11/15/2020	2.5	0.3	4.0	0.4	0.3	0.0	1,529
32	Bent #6 Pile Driving	2	11/15/2020	11/17/2020	18.6	1.9	9.8	1.3	1.0	0.0	3,686
33	Bent #6 Pile Cap Forming	7	11/17/2020	11/24/2020	3.3	0.4	8.1	0.4	0.3	0.0	1,969
34	Bent #6 Pile Cap Pour & Curing	7	11/24/2020	12/1/2020	5.6	0.2	1.9	0.6	0.3	0.0	2,604
35	Bent #6 Pile Cap Forming Removal	7	12/1/2020	12/8/2020	1.6	0.3	3.9	0.4	0.2	0.0	1,248
36	Girder Set #6 Placement	7	12/8/2020	12/15/2020	2.5	0.3	4.0	0.4	0.3	0.0	1,529
37	Bent #7 Pile Driving	2	12/15/2020	12/17/2020	18.6	1.9	9.8	1.3	1.0	0.0	3,686
38	Bent #7 Pile Cap Forming	7	12/17/2020	12/24/2020	3.3	0.4	8.1	0.4	0.3	0.0	1,969
39	Bent #7 Pile Cap Pour & Curing	7	12/24/2020	12/31/2020	5.6	0.2	1.9	0.6	0.3	0.0	2,604
40	Bent #7 Pile Cap Forming Removal	7	12/31/2020	1/7/2021	1.6	0.3	3.9	0.4	0.2	0.0	1,248
41	Girder Set #7 Placement	7	1/7/2021	1/14/2021	2.5	0.3	4.0	0.4	0.3	0.0	1,529
42	Bent #8 Pile Driving	2	1/14/2021	1/16/2021	18.6	1.9	9.8	1.3	1.0	0.0	3,686
43	Bent #8 Pile Cap Forming	7	1/16/2021	1/23/2021	3.3	0.4	8.1	0.4	0.3	0.0	1,969
44	Bent #8 Pile Cap Pour & Curing	7	1/23/2021	1/30/2021	5.6	0.2	1.9	0.6	0.3	0.0	2,604
45	Bent #8 Pile Cap Forming Removal	7	1/30/2021	2/6/2021	1.6	0.3	3.9	0.4	0.2	0.0	1,248
46	Girder Set #8 Placement	7	2/6/2021	2/13/2021	2.5	0.3	4.0	0.4	0.3	0.0	1,529
47	Bent #9 Pile Driving	2	2/13/2021	2/15/2021	18.6	1.9	9.8	1.3	1.0	0.0	3,686
48	Bent #9 Pile Cap Forming	7	2/15/2021	2/22/2021	3.3	0.4	8.1	0.4	0.3	0.0	1,969
49	Bent #9 Pile Cap Pour & Curing	7	2/22/2021	3/1/2021	5.6	0.2	1.9	0.6	0.3	0.0	2,604
50	Bent #9 Pile Cap Forming Removal	7	3/1/2021	3/8/2021	1.6	0.3	3.9	0.4	0.2	0.0	1,248
51	Girder Set #9 Placement	7	3/8/2021	3/15/2021	2.5	0.3	4.0	0.4	0.3	0.0	1,529
52	Abutment #2 Excavation	7	3/15/2021	3/22/2021	4.4	0.3	5.1	0.6	0.3	0.0	2,281
53	Abutment #2 Pile Driving	3	3/22/2021	3/25/2021	18.6	1.9	9.8	1.3	1.0	0.0	3,686
54	Abutment #2 Final Construction	7	3/25/2021	4/1/2021	41.9	1.1	5.7	2.3	1.5	0.2	16,288

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Tasks

Tasks, Durations, and Construction Emissions by Task

ID	Task Name	Duration (days)	Approx. Start Date	Approx. End Date	Max. Daily Construction Emissions (lb/day) NOx	VOC	CO	PM10	PM2.5	SO2	GHG
55	Girder Set #10 Placement	7	4/1/2021	4/8/2021	2.5	0.3	4.0	0.4	0.3	0.0	1,529
56	Crane Demobilization	3	4/8/2021	4/11/2021	1.1	0.1	1.8	0.4	0.2	0.0	911
57	Railroad Track Construction	90	3/12/2021	6/10/2021	18.7	1.0	15.3	1.3	0.9	0.1	7,925
58	Railroad Track Turnout and Crossover Construction	60	6/10/2021	8/9/2021	5.5	0.7	14.0	0.2	0.2	0.0	2,924
59	Asphalt Paving and Fencing	45	8/9/2021	9/23/2021	7.7	6.3	6.4	0.7	0.5	0.0	2,674
	Max. Daily Construction Emissions (reflects overlapping tasks)				60.7	6.3	25.1	9.7	2.3	0.2	24,214

Max. Annual GHG Construction Emissions

	Max. Annual GHG Construction Emissions (metric tons/year)
Max. Annual GHG Construction Emissions	< 685
Total Project GHG Construction Emissions	< 1,127

Notes:

Task ID, Task Name, Equipment, and Duration (Days) from draft 1/29/18 project construction schedule. Start/end dates estimated from Gantt chart.

Task 57 overlaps with Tasks 51-56; all other tasks do not overlap.

Construction duration = ~18 months (2020 - 2021)

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Mobilization

Mobilization

							Max. Daily Construction Emissions (lb/day)						
Equipment/Activity	**Vehicle Type**	**#**	**Hr/ day**	**Hp**	**Load Factor**	**mi/ day**	**NOx**	**VOC**	**CO**	**PM10**	**PM2.5**	**SO2**	**GHG**
Large crawler crane	Offroad	1	0.5	300	0.29	-	0.1	0.0	0.1	0.0	0.0	0.0	51
40-ton crane	Offroad	1	0.5	164	0.29	-	0.1	0.0	0.2	0.0	0.0	0.0	28
Excavator	Offroad	1	0.5	164	0.38	-	0.1	0.0	0.2	0.0	0.0	0.0	37
Loader	Offroad	1	0.5	250	0.36	-	0.1	0.0	0.1	0.0	0.0	0.0	53
Grader	Offroad	1	0.5	183	0.41	-	0.1	0.0	0.1	0.0	0.0	0.0	44
Flatbed truck	Onroad	5		-	-	40	2.2	0.1	0.3	0.0	0.0	0.0	705
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust						-				0.4	0.2		
Total							2.6	0.2	2.3	0.4	0.2	0.0	1,466.9

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])

See Offroad Equipment Details and Onroad Vehicle Details sections for more info.

Fugitive dust includes onroad vehicle travel on paved roads and brake and tire wear.

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Site Removals

Site Removals

Equipment/Activity	**Vehicle Type**	**#**	**Hr/ day**	**Hp**	**Load Factor**	**mi/ day**	**Max. Daily Construction Emissions (lb/day)** NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Excavator	Offroad	1	8	164	0.38	-	1.3	0.1	3.4	0.1	0.1	0.0	585
Loader	Offroad	1	8	250	0.36	-	1.1	0.2	1.7	0.1	0.1	0.0	844
Grader	Offroad	1	8	183	0.41	-	0.9	0.2	1.4	0.0	0.0	0.0	704
Haul truck (10-wheel)	Onroad	54	-	-	-	40	19.9	0.5	1.9	0.1	0.1	0.1	7,737
Flatbed truck	Onroad	3	-	-	-	40	1.3	0.0	0.2	0.0	0.0	0.0	423
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust						-				9.5	1.5		
Total							24.6	1.1	9.9	9.7	1.7	0.1	10,843

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])
See Offroad Equipment Details and Onroad Vehicle Details sections for more info.
Fugitive dust includes grading, soil/material handling, onroad vehicle travel on paved roads, brake and tire wear.

Parameter	Value		Basis/Assumption
Task duration:	60	days	POLA staff
Excavated quantity:	38,000	CY total	POLA staff (3/8/18 estimate): 37,387 CY. CY = cubic yard.
Soil density:	1.26	ton/CY	CalEEMod default (~1.5 g/m3 = approx. density of silty loam soil).
Excavation rate:	798	ton/day	
	634	CY/day	
Haul trucks:	54	trucks/day	max. 15 tons per 10-wheel haul truck.

Fugitive dust from soil handling/drop operations:

AP42, Section 13.2.4 (Aggregate Handling and Storage Piles, 11/2006):

PM10 (lb/ton) = 0.35 * (0.0032) * ((u / 5)^(1.3) / (M / 2)^(1.4))

PM2.5 (lb/ton) = 0.053 * (0.0032) * ((u / 5)^(1.3) / (M / 2)^(1.4))

where u = mean wind speed and M = material moisture content

Parameter	Value		Basis/Assumption
u:	6.4	mph	Long Beach avg wind speed = 6.4 mi/hr (AP42, Ch 7.1 (11/2006), Table 7.1-9)
M:	12	%	CalEEMod default, "Cover" material. (Range: Dry = 2%, Moist = 15%, Wet = 50%)
PM10 :	0.00013	lb/ton	
PM2.5:	0.00002	lb/ton	

Fugitive dust from grading:

AP42, Ch 11.9 (Western Surface Coal Mining, 11/2006), Table 11.9-1:

PM10 (lb/mile) = 0.60 * 0.051 (S)^2.0

PM2.5 (lb/mile) = 0.031 * 0.040 (S)^2.5

where S = mean vehicle speed (mph)

Parameter	Value		Basis/Assumption
S:	4	mph	Estimated mean speed during grading (blade down). Est. range: 2-5 mph for finishing.
PM10 EF:	0.490	lb/mi	

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Site Removals

PM2.5 EF:	0.040	lb/mi	
job efficiency:	50%		estimate (ie. 50% means during 8 hr of operation only 4 hr is grading with blade down)
PM10:	7.83	lb/day	(Grading speed [mi/hr]) * (job efficiency [%]) * (Operation [hr/day])
PM2.5:	0.63	lb/day	

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Abutment (Excavating, Pile Driving, Finishing)

Abutment Excavation

							Max. Daily Construction Emissions (lb/day)						
Equipment/Activity	**Vehicle Type**	**#**	**Hr/ day**	**Hp**	**Load Factor**	**mi/ day**	**NOx**	**VOC**	**CO**	**PM10**	**PM2.5**	**SO2**	**GHG**
Excavator	Offroad	1	8	164	0.38	-	1.3	0.1	3.4	0.1	0.1	0.0	585
Haul truck (10-wheel)	Onroad	8	-	-	-	40	2.9	0.1	0.3	0.0	0.0	0.0	1,146
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust										0.5	0.3		
Total							4.4	0.3	5.1	0.6	0.3	0.0	2,281

Emissions estimates are for one abutment.
Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])
See Offroad Equipment Details and Onroad Vehicle Details sections for more info.
Fugitive dust includes soil/material handling, onroad vehicle travel on paved roads, brake and tire wear.

Parameter	Value		Basis/Assumption
Task duration:	7	days	POLA staff
Excavated quantity:	784	ton	POLA staff (3/3/18 project design): 1,568 tons total for both abutments.
	622	CY	
Soil density:	1.26	ton/CY	CalEEMod default (~1.5 g/m3 = approx. density of silty loam soil).
Excavation rate:	112	ton/day	
	89	CY/day	
Total trucks	8	trucks/day	15 ton capacity per 10-wheel haul truck.

Fugitive dust from soil handling/drop operations:
AP42, Section 13.2.4 (Aggregate Handling and Storage Piles, 11/2006):
PM10 (lb/ton) = 0.35 * (0.0032) * ((u / 5)^(1.3) / (M / 2)^(1.4))
PM2.5 (lb/ton) = 0.053 * (0.0032) * ((u / 5)^(1.3) / (M / 2)^(1.4))
where u = mean wind speed and M = material moisture content

Parameter	Value		Basis/Assumption
u:	6.4	mph	Long Beach avg wind speed = 6.4 mi/hr (AP42, Ch 7.1 (11/2006), Table 7.1-9)
M:	12	%	CalEEMod default 12%, "Cover" material. (Range: Dry = 2%, Moist = 15%, Wet = 50%)
PM10 :	0.00013	lb/ton	
PM2.5:	0.00002	lb/ton	

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Abutment (Excavating, Pile Driving, Finishing)

Abutment Pile Driving

							Max. Daily Construction Emissions (lb/day)						
Equipment/Activity	**Vehicle Type**	**#**	**Hr/ day**	**Hp**	**Load Factor**	**mi /day**	**NOx**	**VOC**	**CO**	**PM10**	**PM2.5**	**SO2**	**GHG**
Large crawler crane	Offroad	1	8	300	0.29	-	1.3	0.2	1.6	0.1	0.1	0.0	816
Pile driver	Offroad	1	4	196	1	-	13.1	1.5	4.8	0.7	0.6	0.0	920
Shuttlelift carrydeck crane	Offroad	1	8	100	0.29	-	0.6	0.1	1.6	0.0	0.0	0.0	272
Flatbed truck	Onroad	8	-	-	-	40	3.5	0.1	0.4	0.0	0.0	0.0	1,128
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust										0.4	0.3		
Total							18.6	1.9	9.8	1.3	1.0	0.0	3,686

Emissions estimates are for <u>one</u> abutment.

See Offroad Equipment Details and Onroad Vehicle Details sections for more info.

Parameter	Value		Basis/Assumption
Pile driving:	0.5	hr/pile	POLA staff: 0.25 hr/pile. Use 0.5 hr/pile for calcs.
Piles daily:	8	piles/day	POLA staff: 8 piles/day (1 hr/pile including setup)
Piles per truck:	1	piles/truck	18 ton/pile (600 lb/ft * 60 ft), 25-ton flatbed truck capacity.
Flatbed trucks daily:	8	trucks/day	

Abutment Finishing

							Max. Daily Construction Emissions (lb/day)						
Equipment/Activity	**Vehicle Type**	**#**	**Hr/ day**	**Hp**	**Load Factor**	**mi /day**	**NOx**	**VOC**	**CO**	**PM10**	**PM2.5**	**SO2**	**GHG**
Concrete boom truck	Onroad	1	-	-	-	30	0.3	0.0	0.0	0.0	0.0	0.0	113
Concrete boom pump	-	-	-	-	-	-	3.7	0.1	0.3	0.0	0.0	0.0	1,443
Concrete mixer truck	Onroad	128	-	-	-	30	37.6	0.9	3.6	0.2	0.2	0.1	14,139
Roller	Offroad	1	2	49	0.38	-	0.3	0.0	0.3	0.0	0.0	0.0	44
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust										2.0	1.3		
Total							41.9	1.1	5.7	2.3	1.5	0.2	16,288

Emissions estimates are for <u>one</u> abutment.

See Offroad Equipment Details and Onroad Vehicle Details sections for more info.

Parameter	Value		Basis/Assumption
Concrete total:	7133	CY	POLA staff (3/8/18 estimate): 14,265 CY total for superstructure.
Pour duration:	7	days	task duration is 7 days
Concrete daily:	1019	CY/day	
Mixer truck capacity:	8	CY/truck	standard concrete mixer truck capacity is 8 CY

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Abutment (Excavating, Pile Driving, Finishing)

Mixer trucks daily: 128 trucks/day

Concrete boom truck pump:

	Concrete pumping emission factors (grams/CY)						
	NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Concrete pumping emission factors	1.6	0.0	0.2	0.0	0.0	0.0	642.1

Factors derived from EMFAC2014 and boom truck pumping fuel use data (41.34-52.1 gal diesel to pump ~825 CY over 5 hours).

Ref:http://concretepumping.com/topic/schwing-runs-fuel-efficiency-test-4-pumps-pumping-into-each-other-for-5-hours

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Bent (Pile Driving, Cap Forming, Cap Pouring, Cap Forming Removal)

Bent Pile Driving

Equipment/Activity	Vehicle Type	#	Hr/day	Hp	Load Factor	mi /day	Max. Daily Construction Emissions (lb/day) NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Large crawler crane	Offroad	1	8	300	0.29	-	1.3	0.2	1.6	0.1	0.1	0.0	816
Pile driver	Offroad	1	4	196	1	-	13.1	1.5	4.8	0.7	0.6	0.0	920
Shuttlelift carrydeck crane	Offroad	1	8	100	0.29	-	0.6	0.1	1.6	0.0	0.0	0.0	272
Flatbed truck	Onroad	8	-	-	-	40	3.5	0.1	0.4	0.0	0.0	0.0	1,128
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust										0.4	0.3		
Total							18.6	1.9	9.8	1.3	1.0	0.0	3,686

Emissions estimates are for one bent.

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])

See Offroad Equipment Details and Onroad Vehicle Details sections for more info.

Fugitive dust includes onroad vehicle travel on paved roads, brake and tire wear.

Parameter	Value		Basis/Assumption
Pile driving:	0.5	hr/pile	POLA staff: 0.25 hr/pile. Use 0.5 hr/pile for calcs.
Piles daily:	8	piles/day	POLA staff: 8 piles/day (1 hr/pile including setup)
Piles per bent:	16	piles/bent	POLA staff
Piles per truck	1	piles/truck	18 ton/pile (600 lb/ft * 60 ft), 25-ton flatbed truck capacity.
Flatbed trucks daily:	8	trucks/day	

Bent Cap Forming

Equipment/Activity	Vehicle Type	#	Hr/day	Hp	Load Factor	mi /day	Max. Daily Construction Emissions (lb/day) NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Large crawler crane	Offroad	1	4	300	0.29	-	0.7	0.1	0.8	0.0	0.0	0.0	408
Compressor	Offroad	4	4	122	0.42	-	2.2	0.2	5.5	0.1	0.1	0.0	962
Welder	Offroad	1	4	25	0.42	-	0.3	0.0	0.4	0.0	0.0	0.0	49
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust										0.3	0.2		
Total							3.3	0.4	8.1	0.4	0.3	0.0	1,969

Emissions estimates are for one bent.

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])

See Offroad Equipment Details and Onroad Vehicle Details sections for more info.

Fugitive dust includes onroad vehicle travel on paved roads, brake and tire wear.

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Bent (Pile Driving, Cap Forming, Cap Pouring, Cap Forming Removal)

Bent Cap Pouring

Equipment/Activity	Vehicle Type	#	Hr/ day	Hp	Load Factor	mi /day	Max. Daily Construction Emissions (lb/day) NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Concrete boom truck	Onroad	1	-	-	-	30	0.3	0.0	0.0	0.0	0.0	0.0	113
Concrete boom pump	-	1	-	-	-	-	0.4	0.0	0.0	0.0	0.0	0.0	174.1
Concrete mixer truck	Onroad	16	-	-	-	30	4.7	0.1	0.5	0.0	0.0	0.0	1,767
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust										0.5	0.3		
Total							5.6	0.2	1.9	0.6	0.3	0.0	2,604

Emissions estimates are for one bent.

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])

See Offroad Equipment Details and Onroad Vehicle Details sections for more info.

Fugitive dust includes onroad vehicle travel on paved roads, brake and tire wear.

Parameter	Value		Basis/Assumption
Task duration:	7	days	POLA staff
Concrete total:	860	CY/bent	POLA staff (3/8/18): 7,684 CY total for piles. Split evenly over 9 bents.
Concrete daily:	123	CY/day	
Mixer truck capacity:	8	CY/truck	estimate
Mixer trucks daily:	16	trucks/day	

Boom truck concrete pump:

	Concrete pumping emission factors (grams/CY) NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Boom truck concrete pump emission factors	1.6	0.0	0.2	0.0	0.0	0.0	642.1

Factors derived from EMFAC2014 and fuel use by two 61-meter boom trucks while pumping (41.34-52.1 gal diesel to pump ~825 CY over 5 hours).

Ref:http://concretepumping.com/topic/schwing-runs-fuel-efficiency-test-4-pumps-pumping-into-each-other-for-5-hours

Bent Cap Forming Removal

Equipment/Activity	Vehicle Type	#	Hr/ day	Hp	Load Factor	mi /day	Max. Daily Construction Emissions (lb/day) NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Large crawler crane	Offroad	1	4	300	0.29	-	0.7	0.1	0.8	0.0	0.0	0.0	408
Compressor	Offroad	1	4	122	0.42	-	0.5	0.1	1.4	0.0	0.0	0.0	240
Welder	Offroad	1	4	25	0.42	-	0.3	0.0	0.4	0.0	0.0	0.0	49
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust										0.3	0.2		
Total							1.6	0.3	3.9	0.4	0.2	0.0	1,248

Emissions estimates are for one bent.

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])

See Offroad Equipment Details and Onroad Vehicle Details sections for more info.

Fugitive dust includes onroad vehicle travel on paved roads, brake and tire wear.

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Girder Set Placement

Girder Set Placement

Equipment/Activity	Vehicle Type	#	Hr/ day	Hp	Load Factor	mi /day	Max. Daily Construction Emissions (lb/day)						
							NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Large crawler crane	Offroad	1	4	300	0.29	-	0.7	0.1	0.8	0.0	0.0	0.0	408
Compressor	Offroad	1	4	122	0.42	-	0.5	0.1	1.4	0.0	0.0	0.0	240
Welder	Offroad	1	4	25	0.42	-	0.3	0.0	0.4	0.0	0.0	0.0	49
Flatbed truck	Onroad	2	-	-	-	40	0.9	0.0	0.1	0.0	0.0	0.0	282
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust						-				0.3	0.2		
Total							2.5	0.3	4.0	0.4	0.3	0.0	1,529.5

Emissions estimates are for one girder set placement.
Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])
See Offroad Equipment Details and Onroad Vehicle Details sections for more info.
Fugitive dust includes onroad vehicle travel on paved roads, brake and tire wear.

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Crane Demobilization

Crane Demobilization

Equipment/Activity	Vehicle Type	#	Hr/ day	Hp	Load Factor	mi /day	Max. Daily Construction Emissions (lb/day)						
							NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Large crawler crane	Offroad	1	0.5	300	0.29	-	0.1	0.0	0.1	0.0	0.0	0.0	51
40-ton crane	Offroad	1	0.5	164	0.29	-	0.1	0.0	0.2	0.0	0.0	0.0	28
Flatbed truck	Onroad	2		-	-	40	0.9	0.0	0.1	0.0	0.0	0.0	282
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust						-				0.3	0.2		
Total							1.1	0.1	1.8	0.4	0.2	0.0	910.6

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])
See Offroad Equipment Details and Onroad Vehicle Details sections for more info.
Fugitive dust includes onroad vehicle travel on paved roads, brake and tire wear.

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Rail Track, Rail Track Turnout and Crossover

Rail Track

Equipment/Activity	Vehicle Type	#	Hr/ day	Hp	Load Factor	mi/ day	Max. Daily Construction Emissions (lb/day) NOx	VOC	CO	PM10	PM2.5	SO2	GHG
10k forklift	Offroad	1	6	110	0.4	-	0.7	0.1	1.8	0.0	0.0	0.0	310
20k forklift	Offroad	1	6	160	0.2	-	0.5	0.1	1.3	0.0	0.0	0.0	225
40k forklift	Offroad	1	6	230	0.2	-	0.4	0.1	0.6	0.0	0.0	0.0	324
Compressor	Offroad	4	6	122	0.42	-	3.3	0.4	8.3	0.1	0.1	0.0	1,442
Welder	Offroad	1	6	25	0.42	-	0.5	0.1	0.6	0.0	0.0	0.0	74
Flatbed truck	Onroad	6	-	-	-	40	2.6	0.1	0.3	0.0	0.0	0.0	846
Haul truck (10-wheel)	Onroad	29	-	-	-	40	10.7	0.3	1.0	0.1	0.0	0.0	4,155
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust						-				1.0	0.6		
Total							18.7	1.0	15.3	1.3	0.9	0.1	7,925

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])
See Offroad Equipment Details and Onroad Vehicle Details sections for more info.
Fugitive dust includes material handling, onroad vehicle travel on paved roads and brake and tire wear.

Parameter	Value		Basis/Assumption
Task duraction:	90	days	POLA staff
Rail track:	30,000	trackfeet	POLA staff (conceptual design): 30,079 TF.
Track daily:	333	TF/day	
	160	TF/truck	136 lb/ft/rail, 40 ft/rail lengths, max. 50,000 lb/truck
Flatbed trucks:	3	trucks/day	
Rail ties:	20,000	ties	1 tie every ~1.5 TF.
Ties daily:	222	ties/day	
Ties per truck:	83	ties/truck	600 lb/tie, max. 50,000 lb/truck
Flatbed trucks:	3	trucks/day	
Ballast:	9,700	CY	~1,700 CY ballast per track-mile.
Bulk density:	1.07	ton/CY	~79 lb/CF loose weight for railroad ballast.
Ballast daily:	115	tons/day	
Haul trucks:	8	trucks/day	max. ~15 tons per 10-wheel haul truck.
Subballast:	21,700	CY	POLA staff (conceptual design): 21,700 CY. Typicallly 12" below ballast.
Bulk density:	1.28	ton/CY	~95 lb/CF loose weight for dry gravel.
Subballast daily:	309	tons/day	
Haul trucks:	21	trucks/day	max. ~15 tons per 10-wheel haul truck.

Negligible fugitive PM10/PM2.5 from Ballast (ballast is washed rock)

Fugitive dust from subballast placement:

AP42, Section 13.2.4 (Aggregate Handling and Storage Piles, 11/2006):

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Rail Track, Rail Track Turnout and Crossover

PM10 (lb/ton) = 0.35 * (0.0032) * ((u / 5)^(1.3) / (M / 2)^(1.4))
PM2.5 (lb/ton) = 0.053 * (0.0032) * ((u / 5)^(1.3) / (M / 2)^(1.4))
where u = mean wind speed and M = material moisture content

Parameter	Value		Basis/Assumption
u:	6.4	mph	Long Beach avg wind speed = 6.4 mi/hr (AP42, Ch 7.1 (11/2006), Table 7.1-9)
M:	12	%	CalEEMod default 12%, "Cover" material. (Range: Dry = 2%, Moist = 15%, Wet = 50%)
PM10 :	0.00013	lb/ton	
PM2.5:	0.00002	lb/ton	

Rail Track Turnout and Crossover

							Max. Daily Construction Emissions (lb/day)						
Equipment/Activity	**Vehicle Type**	**#**	**Hr/ day**	**Hp**	**Load Factor**	**mi /day**	**NOx**	**VOC**	**CO**	**PM10**	**PM2.5**	**SO2**	**GHG**
10k forklift	Offroad	1	6	110	0.4	-	0.7	0.1	1.8	0.0	0.0	0.0	310
20k forklift	Offroad	1	6	160	0.2	-	0.5	0.1	1.3	0.0	0.0	0.0	225
40k forklift	Offroad	1	6	230	0.2	-	0.4	0.1	0.6	0.0	0.0	0.0	324
Compressor	Offroad	4	6	122	0.42	-	3.3	0.4	8.3	0.1	0.1	0.0	1,442
Welder	Offroad	1	6	25	0.42	-	0.5	0.1	0.6	0.0	0.0	0.0	74
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Total							5.5	0.7	14.0	0.2	0.2	0.0	2,924

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])
See Offroad Equipment Details and Onroad Vehicle Details sections for more info.
Fugitive dust includes material handling, onroad vehicle travel on paved roads and brake and tire wear.

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Asphalt Paving and Fencing

Asphalt Paving and Fencing

Equipment/Activity	Vehicle Type	#	Hr/ day	Hp	Load Factor	mi/ day	Max. Daily Construction Emissions (lb/day) NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Paver	Offroad	1	8	75	0.42	-	1.6	0.1	1.9	0.1	0.1	0.0	296
Roller	Offroad	1	8	49	0.38	-	1.1	0.1	1.3	0.0	0.0	0.0	175
Skid Steer Loader (Auger)	Offroad	1	8	61	0.37	-	1.1	0.1	1.4	0.0	0.0	0.0	212
Haul truck (10-wheel)	Onroad	7	-	-	-	40	2.6	0.1	0.2	0.0	0.0	0.0	1,003
Concrete mixer truck	Onroad	3	-	-	-	30	0.9	0.0	0.1	0.0	0.0	0.0	331
Water truck	Onroad	1	-	-	-	30	0.3	0.0	0.0	0.0	0.0	0.0	108
Worker commute	Onroad	20	-	-	-	40	0.1	0.1	1.4	0.0	0.0	0.0	550
Fugitive dust						-				0.5	0.3		
Paving Fugitive VOC						-		0.2					
Striping Fugitive VOC						-		5.7					
Total							7.7	6.3	6.4	0.7	0.5	0.0	2,674

Offroad equipment emissions = (#) * (Hr/day) * (Hp) * (Load Factor) * (Emission Factor [g/hp-hr])
See Offroad Equipment Details and Onroad Vehicle Details sections for more info.
Fugitive dust includes material handling, onroad vehicle travel on paved roads and brake and tire wear.

Parameter	Value	Basis/Assumption
Task duration:	45 days	POLA staff
Asphalt total:	4,513 tons	POLA staff (11/1/16 Class "C" cost estimate): 4,513 ton.
Asphalt paving rate:	100.3 tons/day	
Haul trucks:	7 truck/day	15-ton max. per 10-wheel haul truck.

Fugitive dust from soil handling/drop operations:

AP42, Section 13.2.4 (Aggregate Handling and Storage Piles, 11/2006):

PM10 (lb/ton) = 0.35 * (0.0032) * ((u / 5)^(1.3) / (M / 2)^(1.4))

PM2.5 (lb/ton) = 0.053 * (0.0032) * ((u / 5)^(1.3) / (M / 2)^(1.4))

where u = mean wind speed and M = material moisture content

Parameter	Value	Basis/Assumption
u:	6.4 mph	Long Beach avg wind speed = 6.4 mi/hr (AP42, Ch 7.1 (11/2006), Table 7.1-9)
M:	12 %	CalEEMod default 12%, "Cover" material. (Range: Dry = 2%, Moist = 15%, Wet = 50%)
PM10 :	0.00013 lb/ton	
PM2.5:	0.00002 lb/ton	

Emissions estimates conservatively assume no mitigation from watering.

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Asphalt Paving and Fencing

Paving fugitive VOC:

Parameter	Value		Basis/Assumption
VOC EF	2.62	lb/acre	CalEEMod default.
Asphalt quantity:	4513	tons	see above
Paving depth:	0.5	ft	POLA staff.
Asphalt density:	2	ton/CY	145 lb/cf typical
Paved area:	2.80	acres	
Paving days:	45	days	task duration
Paving rate:	0.06	acres/day	
VOC daily:	0.16	lb/day	

Striping VOC:

Parameter	Value		Basis/Assumption
VOC content:	100	g/L	SCAQMD VOC limit for traffic coatings is 100 g/L.
Coating usage:	12	gal/mile	estimate, per stripe.
Stripes:	2	stripes	estimate
Stripe length:	2	mi./stripe	estimate
Coating usage:	48	gal	
VOC:	40.1	lb	
Striping rate:	7	days	estimate
VOC daily:	5.73	lb/day	

Fencing:

Parameter	Value		Basis/Assumption
Duration	10	days	estimate
Fence length:	7000	ft	Estimate
Fence posts:	1168	posts	6 ft apart
Concrete:	0.18	CY/post	4' deep x 1.25' dia. Every 6 ft
	210.2	CY	
	21.0	CY/day	
Mixer truck capacity:	8	CY/truck	8 CY standard capacity truck
Mixer trucks daily:	3	trucks/day	

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Offroad Diesel Equipment Details

Offroad Diesel Equipment Details

Equipment Description	CARB Off-Road Category (for Load Factor)	Load Factor	Engine Rating (hp)	Fuel	Engine Model Year	CHrs (hr)	Fuel Use (gal/hr)	Exhaust Emission Factor (g/hp-hr)						
								NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Loader	Rubber Tired Loaders	0.36	250	DSL	2015	5,000	4.65	0.69	0.13	1.04	0.036	0.033	5.0E-03	532
Excavator	Excavators	0.38	164	DSL	2015	5,000	3.22	1.20	0.13	3.06	0.055	0.051	5.0E-03	532
Grader	Graders	0.41	183	DSL	2015	5,000	3.88	0.69	0.13	1.04	0.036	0.033	5.0E-03	532
Large crawler crane	Cranes	0.29	300	DSL	2015	5,000	4.50	0.87	0.13	1.01	0.042	0.039	5.0E-03	532
Pile driver	None (pile driver, assume 100% load factor)	1.00	196	DSL	1995	1,250	11	7.55	0.87	2.79	0.404	0.371	5.0E-03	532
40-ton crane	Cranes	0.29	164	DSL	2015	5,000	2.46	1.20	0.13	3.06	0.055	0.051	5.0E-03	532
Compressor	Other Construction Equipment	0.42	122	DSL	2015	5,000	2.65	1.20	0.13	3.06	0.055	0.051	5.0E-03	532
Welder	Other Construction Equipment	0.42	25	DSL	2015	5,000	0.54	3.44	0.36	4.10	0.112	0.103	5.0E-03	532
Office trailer generator	Rough Terrain Forklifts	0.40	25	DSL	2015	5,000	0.52	3.44	0.36	4.10	0.112	0.103	5.0E-03	532
Paver	Pavers	0.42	75	DSL	2015	5,000	1.63	2.90	0.13	3.46	0.225	0.207	5.0E-03	532
Roller	Rollers	0.38	49	DSL	2015	5,000	0.96	3.44	0.36	4.10	0.112	0.103	5.0E-03	532
Skid Steer Loader (Auger)	Skid Steer Loaders	0.37	61	DSL	2015	5,000	1.17	2.87	0.27	3.46	0.052	0.048	5.0E-03	532
10k forklift	Rough Terrain Forklifts	0.40	110	DSL	2015	5,000	2.27	1.20	0.13	3.06	0.055	0.051	5.0E-03	532
20k forklift	Forklifts	0.20	160	DSL	2015	5,000	1.65	1.20	0.13	3.06	0.055	0.051	5.0E-03	532
40k forklift	Forklifts	0.20	230	DSL	2015	5,000	2.38	0.69	0.13	1.04	0.036	0.033	5.0E-03	532
Shuttlelift carrydeck crane	Cranes	0.29	100	DSL	2015	5,000	1.50	1.20	0.13	3.06	0.055	0.051	5.0E-03	532

Notes:
Load factors from CARB's 2010 OFFROAD model (Table D-7: https://www.arb.ca.gov/regact/2010/offroadlsi10/offroadappd.pdf)
All offroad diesel construction equipment assumed to be 5 years old or newer at start of construction in 2020 (exceptIon: pile driver conservatively modeled as a 25-year old engine).
NOx, THC, CO, and PM10 diesel emission factors from CARB's "2017 Off-road Diesel Emission Factors" (https://www.arb.ca.gov/msei/ordiesel/ordas_ef_fcf_2017_v7.xlsx)
VOC (ROG) calculated from THC assuming VOC = 1.21 * THC for diesel (CARB, https://www.arb.ca.gov/msei/ordiesel/rog_tog_hcratio.xls).
PM2.5 calculated from PM10 assuming PM2.5 = 0.92 * PM10 for diesel (CARB, https://www.arb.ca.gov/msei/ordiesel/pm25_pm10reference.pdf).
SO2 EF calculated from fuel sulfur content and engine BSFC. Details below.
CO2 EF calculated from EPA CO2 EF for mobile diesel sources and engine BSFC. Details below.
CH4 and N2O calculated from EPA CH4 and N2O factors for diesel construction equipment and engine BSFC. Details below.
Fuel used estimated based on GHG emission factor or equipment specs.

POLA Pier 400/Terminal Island Railyard Enhancement Project

Construction Emissions - May 2018

Offroad Diesel Equipment Details

CHrs = operating hours accumulated on the equipment. Used to estimate emission factor deterioration rates (for NOx, VOC, CO, PM10) due to equipment wear/aging.

EF = Zh + Dr * CHrs, where:

Zh = Zero-hour emission rate, when equipment is new (g/hp-hr) - from CARB's "2017 Off-road Diesel Emission Factors" ("ordas_ef_fcf_2017_v7.xlsx")

Dr = Deterioration rate or increase in Zh emission rate (g/hp-hr2) - from CARB's "2017 Off-road Diesel Emission Factors" ("ordas_ef_fcf_2017_v7.xlsx")

CHrs = cumulative hours or total number of hours accumulated on the equipment (hr)

Parameter	Value		Basis
Annual usage:	1000	hr/yr	all equipment except pile driver (which assumes 2 hr/day, 125 days/yr usage for 5 years)
CHrs total = CHrs * (2020 - Engine Model Year)			
Deterioration rates vary by engine size (hp).			

SO2 emission factor calculated from sulfur content of fuel and estimated engine BSFC:

Parameter	Value		Basis
Engine BSFC:	0.367	lb/hp-hr	CARB OFFROAD2011 model. Assumes same BSFC across all HP ranges.
Diesel max. sulfur content:	15	ppmw as S	ULSD max. is 15 ppmw as S.
SO2 EF:	0.005	g/hp-hr	Calc

GHG emission factor:

Parameter	Value		Basis
Engine BSFC:	0.367	lb/hp-hr	CARB OFFROAD2011 model. Assumes same BSFC across all HP ranges.
CO2 EF for diesel:	10.21	kg/gal	Table A-1, EPA Mobile Combustion CO2 Emission Factors, https://www.epa.gov ("emission-factors_nov_2015_v2.pdf")
CO2 EF:	527.8	g/hp-hr	diesel density = 7.1 lb/gal.
CH4 EF	0.57	g/gal	Table 5, EPA Mobile Combustion CH4 and N2O Emission Factors for Non-Road Vehicles
	0.0295	g/hp-hr	diesel density= 7.1 lb/gal, BSFC=0.367 lb/hp-hr
N2O EF:	0.26	g/gal	Table 5, EPA Mobile Combustion CH4 and N2O Emission Factors for Non-Road Vehicles
	0.0134	g/hp-hr	diesel density 7.1 lb/gal, BSFC=0.367 lb/hp-hr
CO2 GWP	1		2014 IPCC Fifth Assessment Report (AR5), http://www.ipcc.ch/report/ar5/
CH4 GWP:	28		2014 IPCC Fifth Assessment Report (AR5), http://www.ipcc.ch/report/ar5/
N2O GWP:	265		2014 IPCC Fifth Assessment Report (AR5), http://www.ipcc.ch/report/ar5/
GHG EF:	532	g/hp-hr	GHG = CO2e = (CO2 GWP)*CO2 + (CH4 GWP)*CH4 + (N2O GWP)*N2O

Diesel pile hammer:

Diesel fuel usage:	11	gal/hr	Delmag spec sheet (11 gal/hr for 15,000 kg Delmag D150).
BSFC:	0.4	lb/hp-hr	estimate. Assumes lower fuel efficiency than typical 4-stroke diesel engine.
Hp estimate:	196	hp	hp = (Diesel usage [gal/hr]) * (7.1 [lb/gal]) / (BSFC [lb/hp-hr])

POLA Pier 400/Terminal Island Railyard Enhancement Project
Construction Emissions - May 2018
Onroad Vehicle Details

Onroad Vehicle Details

Vehicle Description	EMFAC Vehicle Class	Engine Model Year	Fuel	Fuel Use (gal/day)	Distance (mile/ day)	Idling (min/ day)	Daily Emissionsm, excluding Fugitive Dust (lb/day/vehicle) NOx	VOC	CO	PM10	PM2.5	SO2	GHG	Fugitive dust (lb/day/veh) PM10	PM2.5
Haul truck (10-wheel)	T7 Single	Aggregated	DSL	6.36	40	10	0.368	0.009	0.035	0.002	0.002	0.001	143.3	0.01808	0.01131
Flatbed truck	T7 tractor	Aggregated	DSL	6.26	40	10	0.432	0.013	0.052	0.002	0.002	0.001	141.0	0.01808	0.01131
Concrete boom truck	T7 Single	Aggregated	DSL	5.02	30	40	0.308	0.007	0.030	0.001	0.001	0.001	113.0	0.01356	0.00848
Concrete mixer truck	T7 Single	Aggregated	DSL	4.91	30	25	0.294	0.007	0.028	0.001	0.001	0.001	110.5	0.01356	0.00848
Water truck	T7 Single	Aggregated	DSL	4.79	30	10	0.279	0.007	0.027	0.001	0.001	0.001	107.9	0.01356	0.00848
Worker commute	LDA	Aggregated	GAS	1.42	40	0	0.006	0.003	0.070	0.000	0.000	0.000	27.5	0.01499	0.00816

	Exhaust Emission Factors (grams/mile)							Fugitive Dust: Brake and Tire Wear Factors (grams/mile)				Fugitive Dust: Road Dust (grams/mile)	
Vehicle Description	NOx	VOC	CO	PM10	PM2.5	SO2	GHG	PM10-Tire Wear	PM10-Brake Wear	PM2.5-Tire Wear	PM2.5-Brake Wear	PM10	PM2.5
Haul truck (10-wheel)	4.066	0.095	0.387	0.020	0.019	0.015	1605	0.036	0.062	0.009	0.026	0.16	0.04
Flatbed truck	4.782	0.141	0.574	0.023	0.022	0.015	1578	0.036	0.062	0.009	0.026	0.16	0.04
Concrete boom truck	4.066	0.095	0.387	0.020	0.019	0.015	1605	0.036	0.062	0.009	0.026	0.16	0.04
Concrete mixer truck	4.066	0.095	0.387	0.020	0.019	0.015	1605	0.036	0.062	0.009	0.026	0.16	0.04
Water truck	4.066	0.095	0.387	0.020	0.019	0.015	1605	0.036	0.062	0.009	0.026	0.16	0.04
Worker commute	0.061	0.015	0.729	0.002	0.002	0.003	309	0.008	0.037	0.002	0.016	0.16	0.04

	Idling Emission Factors (g/hr)							Startup/Hotsoak/Runloss Emission Factors (g/trip/vehicle)						
Vehicle Description	NOx	VOC	CO	PM10	PM2.5	SO2	GHG	NOx	VOC	CO	PM10	PM2.5	SO2	GHG
Haul truck (10-wheel)	26.86	0.739	2.940	0.015	0.014	0.045	4669	0	0	0	0	0	0	0
Flatbed truck	29.17	0.864	3.448	0.010	0.009	0.049	5090	0	0	0	0	0	0	0
Concrete boom truck	26.86	0.739	2.940	0.015	0.014	0.045	4669	0	0	0	0	0	0	0
Concrete mixer truck	26.86	0.739	2.940	0.015	0.014	0.045	4669	0	0	0	0	0	0	0
Water truck	26.86	0.74	2.940	0.015	0.014	0.045	4669	0	0	0	0	0	0	0
Worker commute	0	0	0	0	0	0	0	0.091	0.449	1.398	0.0024	0.0022	0.0007	63.0

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Notes:

NOx, VOC, CO, PM10, PM2.5, SO2, and CO2 emission factors (except road dust) from CARB's EMFAC2014 (v1.0.7) model for calendar year 2020 and assume aggregated speeds and model years.

Road dust emission factors calculated using EPA's AP42 entrained road dust equation (see below).

Daily emissions (DSL vehicles) = (miles/day) * (EF [g/mile]) + (idling time [min/day]) / (60 [min/hr]) * (Idling EF [g/hr])

Daily emissions (GAS vehicles) = (miles/day) * (EF [g/mile]) + (2 [trips/day]) * (EF [g/trip/vehicle])

For worker commute vehicles, 2 trips/day assumed for startup/hotsoak/runloss emissions.

LDA = Light-duty automobile

CalEEMod default Home-Work trip length in South Coast Air Basin is 19.8 miles (Rural) and 14.7 miles (Urban). Emissions estimates assume 20 miles (40 miles roundtrip).

Fuel use estimated from GHG emissions.

Fugitive dust for PAVED roads:

EPA's AP42, Chapter 13.2.1 (Paved Roads, 1/2011):

PM10 EF (g/mile) = 1 * (sL)^(0.91) * (W)^(1.02)

PM2.5 EF (g/mile) = 0.25 * (sL)^(0.91) * (W)^(1.02)

where sL = surface silt loading (g/m2), W = average vehicle weight (ton)

Parameter	Value		Basis/Assumption
sL:	0.050	g/m2	Road mix estimate for Los Angeles Co.: 20% Freeway @ 0.015 g/m2 , 50% Major/Collector @ 0.013 g/m2. 30% Local @ 0.135 g/m2. sL from CARB, Methodology 7.9 (Entrained Road Travel, Paved Road Dust) Nov 2016, Table 3, https://www.arb.ca.gov/ei/areasrc/fullpdf/full7-9_2016.pdf
W:	2.4	tons	CalEEMod v2016.3.2 default. Estimated avg weight of ALL vehicles traveling on roads.
PM10:	0.160	g/mile	
PM2.5:	0.040	g/mile	

Per AP42, paved road EF Is applied using fleet avg weight of ALL vehicles traveling on road (not applied by vehicle weight class).

Road dust emissions assume no credit/reduction for precipitation.

Fugitive dust for UNPAVED roads:

None for South Coast Air Basin, per CalEEMod Appendix D (Table 4.1 Road Characteristics): South Coast Air Basin default is 100% paved roads for Construction Worker, Construction Hauling, and Construction Vendor trips.

GHG EF:

GHG = CO2e = (CO2 GWP)*CO2 + (CH4 GWP)*CH4 + (N2O GWP)*N2O

GWP = Global Warming Potential

	Value	Basis
CO2 GWP	1	2014 IPCC Fifth Assessment Report (AR5), http://www.ipcc.ch/report/ar5/
CH4 GWP:	28	2014 IPCC Fifth Assessment Report (AR5), http://www.ipcc.ch/report/ar5/
N2O GWP:	265	2014 IPCC Fifth Assessment Report (AR5), http://www.ipcc.ch/report/ar5/

CH4 and N2O:

Vehicle type	CH4 (g/mile)	N2O (g/mile)
DSL	0.0051	0.0048
GAS	0.0358	0.0473

Table B-1, https://www.epa.gov/sites/production/files/2016-03/documents/mobileemissions_3_2016.pdf

DSL EFs are for Medium and Heavy Duty Diesel and assumed to apply to all on-road diesel vehicles identified above.

GAS EFs are for 1995 model year gasoline passenger car (25-year old vehicle is conservative assumption) and are assumed to apply to all on-road gasoline vehicles identified above.

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CO2 emission factor:

	Value		Basis
Gasoline CO2 EF:	8.78	kg/gal	Table 2, EPA Mobile Combustion CO2 Emission Factors, https://www.epa.gov/sites/production/files/2016-09/documents/emission-factors_nov_2015_v2.pdf
Diesel CO2 EF:	10.21	kg/gal	Table A-1, EPA Mobile Combustion CO2 Emission Factors, https://www.epa.gov/sites/production/files/2016-09/documents/emission-factors_nov_2015_v2.pdf

Operation

Terminal and Rail Capacity Analyses

A container terminal capacity analysis was conducted for the Pier 400 container terminal as a whole (including APMT terminal and former CUT terminal). To estimate terminal capacity, the POLA and most ports in the world use a methodology that relies on two capacity models, one that analyzes the terminals' container yard (CY) capacity and one that analyzes the terminals' berth capacity (a terminal could be berth constrained or backlands constrained or evenly balanced between the two). Key model variables include: the length of berth, number/size of berth cranes, size of vessels, berth crane productivity, size of the storage area, how the containers are stored (i.e., chassis vs. grounded) and how long the containers remain in storage (container dwell time), and operating hours for the berth and the yard. This analysis determined that the wharf capacity is less than the CY capacity, and thus is the governing capacity. The terminal capacity is estimated to be 4.852 million twenty-foot equivalent (TEU) per year.

An analysis was also conducted to estimate the increase in capacity and commensurate use of the APMT on-dock railyard. The on-dock railyard as a whole is comprised of the existing loading/working tracks in the APMT terminal, and the storage tracks located on the Pier 400 Transportation Corridor, in which the expansion of the latter component (by 31,000 lineal feet of track) is the proposed Terminal Island (TI) Railyard Enhancement project. The proposed improvements will increase the railyard capacity and ultimately commensurate use by approximately 525,200 TEU/year, under year 2040 conditions. Hence, these same amount of containers will shift from off-dock railyards to the on-dock railyard. This shifting of off-dock to on-dock use potentially reduces the dwell time of these same containers in the APMT terminal, by a day or so, which theoretically could increase the container yard capacity a nominal amount. However, since the APMT terminal limiting capacity is that of the wharf, the increased on-dock railyard use will not increase the total terminal volume. Thus, the net effect of the proposed storage tracks is the shifting about 525,200 TEU/year from off-dock yards to the APMT on-dock yard (by the year 2040). The following table summarizes the resultant terminal and on-dock volumes analyzed for two horizon years.

Table 1 - Container Volumes

	Total Volume	On-dock Volume
Year 2021 w/o project	2,879,500	730,300
Year 2021 w/project	2,879,500	891,000
Year 2040 w/o project	4,852,200	1,037,400
Year 2040 w/project	4,852,200	1,562,600

Truck Traffic Analysis

The capacity/use increase of the Pier 400 on-dock railyard will result in the shifting of 525,250 TEU/year from the following three off-dock railyards: Union Pacific Railroad (UP) Intermodal Container Transfer Facility (ICTF); UP East Los Angeles (ELA) yard on East Washington Boulevard in the City of Commerce; and the Burlington Northern-Santa Fe Railway (BNSF) Hobart yard located on Washington Boulevard in the City of Vernon. Using Year 2021 and Year 2040 container volume projections on-dock railyard capacity increases/utilization, the truck trip estimates and reductions have been quantified using the Ports of Los Angeles and Long Beach container trip generation model, called "QuickTrip." This model has been used on all POLA environmental documents since 2002, and is constantly updated and enhanced. The trip generation model and direct output is also used by the Southern California Association of Governments (SCAG) in their federally-required Regional Transportation Plan (RTP).

Using comprehensive port-specific truck trip generation and the POLA's travel demand model (Port Area Travel Demand Model, PortTAM), the TI Railyard Enhancement project truck volumes on the regional roadway system were produced for year 2021 and 2040 conditions, without and with the expanded TI Railyard. The PortTAM is a detailed, focus model of SCAG's RTP model, and includes truck and/or auto trips for: all container terminals in the POLA and Port of Long Beach (POLB); all other cargo terminals and facilities within the POLA/POLB boundaries; off-dock intermodal railyards owned and operated by the UPRR and BNSF railroads; ILWU labor dispatch halls; Port of Los Angeles World Cruise Center; Ports 'O Call; the Carnival Cruise terminal; and the Queen Mary. Since its inception, POLA/POLB have constantly updated PortTAM to account for: updated POLA/POLB cargo forecasts and resultant truck and auto trips; land use changes/forecasts and specific development projects within a 3-5 mile radius of the Ports; constant logistics operations research that affects truck trips, such as on-dock and of-dock rail mode splits, empty container management, chassis management, dual transactions in the terminals, street-turns, and terminal operating hours; roadway system changes; and of course SCAG RTP model updates every four years, when they are released publically. The logistics elements represent the structure of the aforementioned "Quicktrip model. SCAG also updates their RTP model to incorporate the POLA/POLB PortTAM updates. The POLA's' models are also contained in other agency models and project, such as (but not limited to) the Southern California Association of Governments (SCAG) Regional Transportation Plan (RTP), the Gateway Cities Council of Governments' Strategic Transportation Plan, and the ongoing Caltrans/Los Angeles County Metropolitan Transportation Authority I-710 Corridor Project I-710 Corridor Project Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (State of California, July 2017).

The difference in the PortTAM model results for the two analysis scenarios represents the shifting of containers from the off-dock railyards to the on-dock railyards. The shifted amounts from the three railyards were computed using detailed historical shares of off-dock volumes between the UP and BNSF. This data yielded the following shares for the shitted containers: BNSF – 50%, UP ICTF - 45%, UP ELA – 5%. These shares have been used for many years, including recent POLA environmental documents, the I-710 EIR/EIS, and the SCAG RTP. This shifting of containers will remove truck trips and reduce truck-miles traveled (TMT), which in turn reduces delay and increases vehicle-hours traveled (VHT) for all other motorists, as follows:

TI Railyard Enhancement Daily Reductions Truck Trips, Truck Miles-Traveled & Hours-Traveled (for all motorists)			
Year	Trips	Miles	Hours
2021	-560	-7,220	-350
2040	-1,520	-19,720	-7,980

To yield reasonable and conservative results, an increment of only 161,000 TEU/year in on-dock volume was assumed under year 2021 conditions. This value was estimated considering intermodal growth and actual volumes at the AMPT railyard over the last ten years. The PortTAM model was then used to produce the TMT and VHT results.

<u>Rail Analysis</u>. The shift in containers being moved via off-dock yards to the APMT on-dock railyard will result in a small increase in on-dock rail volumes moving to/from the APMT railyard and the northern end of the Alameda Corridor, just east of both the UP ELA yard and the BNSF Hobart yard. There will be no net increase rail volumes easterly of these locations on the UPRR and BNSF rail lines because these shifted containers would have been otherwise loaded/unloaded onto trains in the ELA and Hobart railyards without the proposed TI railyard project. Similarly, there will also be a small increase in train volumes between the UP ICTF and the APMT railyard, (in addition to the shift from the ELA and Hobart yards).

The shift in containers being moved via from off-dock yards to the APMT on-dock railyard will result in a small increase in on-dock rail volumes and resulting locomotive emissions, between the Terminal Island Railyard The rail volumes were estimated for year 2021 and year 2040 conditions using the following basic factors:

- Total on-dock volumes, not just the estimated increment
- average rail car length (depends on mix of cars of varying lengths that make up the trains)
- locomotive length
- number of locomotives per train for different train lengths
- slot utilization (percentage of rail car capacity actually used by containers); e.g.; a five-well railcar can hold 10 double-stacked containers; typical utilization is about 95% on average for eastbound trains
- market-wise distribution of trains by length (percentage of trains that are 6,000 feet, 8,000 feet, 10,000 feet, and 12,000 feet long, including locomotives);
- switching movements (less than full unit trains) to/from the TI Railyard storage/staging yard (only uses one locomotive).

- proportion of shifting from ELA yard, ICTF, & Hobart yard

There are no at-grade rail-roadway crossings between the POLA and the ELA and Hobart yards. Thus, the small number of additional on-dock train movements will not have any traffic impacts. The TI Railyard project will also improve the movement of trains on Terminal Island, thus reducing train delays (operating hours), but this particular benefit has not been quantified.

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Emissions and Noise. The reduced VMT was used to compute reduced emissions. The net emission reductions also account for the low amount of increased train emissions due to the shifting from use of off-dock to on-dock trains discussed above. The emission reductions are understated as they only account for the reduced truck trips and increased locomotives, but not the reduced emissions attributable to the reduced travel time of all other motorists. The TI Railyard Enhancement also reduces freeway noise as a result of fewer truck trips to off-dock facilities.

The emissions analysis includes criteria pollutants and GHGs, for peak day and annual time periods, for 2021 and 2040, for the four scenarios above. Emission factors for exhaust, tire wear, and brake wear by speed and were generated by the California Air Resources Board EMFAC2014 model. The truck emissions account for the future truck mix (truck age distribution), accounting for turnover of existing trucks over 20 years, as estimated by the Ports and their consultants. These detailed truck mix forecasts account for actual, existing truck information collected via the Ports' annual emissions inventory (EI) work (*https://www.portoflosangeles.org/pdf/2016_Air_Emissions_Inventory.pdf*) and these emission calculation methodologies were also used in the POLA/POLB's recently approved 2017 Clean Air Action Plan (http://www.cleanairactionplan.org). **Such fleet forecasts were developed in concert with the Ports' EI working group that includes EPA, CARB, and SCAQMD**. The PM10 and PM2.5 emissions also include the contribution from re-entrained road dust, based on emission factors derived from the CARB Emission Inventory Chapter 7.9, "Miscellaneous Process Methodology, Entrained Road Travel, Paved Road Dust" (November 2016). Moving emissions also depend on the estimated VMT and average daily speed on each analyzed roadway segment that have reduced truck trips between the APMT terminal and the off-dock railyards.

The locomotive emission estimates utilized detailed train speeds generated via the POLA's "Rail Traffic Controller" (RTC) simulation model, for the years 2021 and 2040 conditions. This model is utilized universally by Class I railroads, ports, and commuter passenger rail agencies throughout North America. Varying train speeds generated by the RTC model were used for various segments inside and outside the POLA, including along the Alameda Corridor.

Assumptions Used in the Locomotive Emission Calculations

Parameter	Value	Unit of Measure	Reference
Line Haul Fuel Consumption Rate	20.8	hp-hr/gal	Inventory of Air Emissions CY 2016, Page 46; EPA Office of Transportation and Air Quality, "Emission Factors for Locomotives", EPA-420-F-09-025, April 2009.
Global Warming Potential, CO2	1	(unitless)	EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, April 2017
Global Warming Potential, CH4	25	(unitless)	EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, April 2017
Global Warming Potential, N2O	298	(unitless)	EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, April 2017
Average POLA Train Composition	494	TEUs	Inventory of Air Emissions CY 2013, Page 149
Average POLA Train Composition	274	containers	Inventory of Air Emissions CY 2013, Page 160
Average POLA Train Weight	7276	gross tons	Inventory of Air Emissions CY 2013, Page 160
Average POLA Train Weight per TEU	14.7	gross tons/TEU	Calculated from Average Train Composition and Average Train Weight
Diesel engine conversion factor, HC to VOC	1.053	(unitless)	EPA. Conversion Factors for Hydrocarbon Emission Components. Report No. NR-002d. EPA-420-R-10-015. July 2010.
Conversion Factor for Diesel Engines, PM10 to PM2.5	0.92	(unitless)	SCAQMD, Updated CEIDARS Table with PM2.5 Fraction, Appendix A of PM2.5 Significance Thresholds and Calculation Methodology. http://www.aqmd.gov/ceqa/handbook/PM2_5/PM2_5.html.
Diesel fuel density	7.05	lb/gal	POLA 2013 Air Emissions Inventory, pg. 151 (expressed as 3,200 g/gal)
Ratio Annual/Peak Day for Rail, 2021 & 2041	327.1	(unitless)	Cambridge Systematics. Email from Chiranjivi Bhamidipati. File "DR1_APMT_INFRA_Grant_RailTraffic_CSBv7_20170922.xlsx". September 22, 2017.
Ratio Annual/Peak Day for Trucks, 2021 & 2041	247.0	(unitless)	China Shipping Draft Supplemental EIR, 2017. Appendix B1, Tables B1-148 and B1-244. Assume the peaking factors in 2021 and 2041 are the same as years 2023 and 2045. Confirmed by Ramesh Thammiraju/CSI, telephone conversation, 9/12/17.
Line Haul Fuel Productivity Factor, 2011	696	gross ton-miles/gal	Source: ARB, Locomotive Inventory Update: Line Haul Activity (2014). South Coast Air Basin.
Line Haul Fuel Productivity Factor, 2012	703	gross ton-miles/gal	Calculated. Assume that the productivity factor will increase by 1% each year until 2050. Source: ARB, Locomotive Inventory Update: Line Haul Activity (2014).
Line Haul Fuel Productivity Factor, 2013	710	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2014	717	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2015	724	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2016	732	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2017	739	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2018	746	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2019	754	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2020	761	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2021	769	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2022	777	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2023	784	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2024	792	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2025	800	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2026	808	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2027	816	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2028	824	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2029	833	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2030	841	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2031	849	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2032	858	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2033	866	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2034	875	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2035	884	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2036	893	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2037	901	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2038	911	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2039	920	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2040	929	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2041	938	gross ton-miles/gal	Calculated

Line Haul Fuel Productivity Factor, 2042	947	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2043	957	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2044	967	gross ton-miles/gal	Calculated
Line Haul Fuel Productivity Factor, 2045	976	gross ton-miles/gal	Calculated

Loco Route Nodes (from BEEST)

Segment Length (meters): 12453.5
Segment Length (miles): 7.74

Train Route for Segment 1: APMT On-dock Yard to ICTF Jct. (South of ICTF Yard)

UTM X (m)	UTM Y (m)	Distance (m)
384518.0	3735169.8	--
384500.4	3735226.7	59.5
384489.1	3735271.3	46.0
384482.3	3735306.8	36.1
384477.5	3735351.7	45.2
384471.9	3735382.0	30.8
384463.1	3735407.9	27.4
384385.9	3735638.2	242.9
384373.4	3735676.6	40.4
384369.2	3735695.9	19.7
384366.8	3735733.9	38.1
384371.7	3735773.6	40.1
384383.9	3735812.5	40.7
384406.2	3735852.5	45.7
384437.3	3735886.7	46.3
384472.9	3735911.9	43.6
384514.5	3735937.0	48.6
384672.9	3736034.3	185.9
384766.2	3736096.0	111.9
384883.2	3736168.2	137.4
384962.4	3736221.6	95.5
385047.9	3736291.9	110.7
385073.8	3736319.5	37.9
385128.2	3736384.1	84.5
385153.6	3736422.1	45.8
385174.2	3736470.1	52.1
385183.6	3736522.6	53.4
385180.7	3736630.6	108.0
385178.6	3736698.4	67.8
385166.9	3736818.5	120.7
385154.0	3736989.1	171.1
385148.8	3737044.3	55.5
385131.4	3737184.4	141.2
385110.5	3737458.9	275.2
385093.6	3737669.8	211.6
385083.4	3737893.9	224.3
385087.3	3737944.9	51.2
385102.1	3738027.5	83.8
385147.8	3738234.5	212.0
385165.2	3738299.1	66.9
385223.1	3738411.1	126.1
385306.7	3738546.3	159.0
385381.2	3738666.9	141.7
385412.4	3738743.5	82.7
385431.3	3738830.4	89.0
385436.5	3738908.5	78.3
385434.8	3738972.6	64.1
385428.5	3739123.8	151.3

Source for segment endpoints: Emails from Kerry Cartwright/POLA, 8/16/17, 9/5/17, and 9/19/17.

Segment Length (meters): 28548.6
Segment Length (miles): 17.74

Train Route for Segment 2: ICTF Jct. to L.A. Downtown (North of ICTF Yard)

UTM X (m)	UTM Y (m)	Distance (m)
387286.6	3746698.2	--
387306.6	3746790.9	94.9
387332.9	3746960.3	171.5
387371.5	3747225.6	268.0
387377.4	3747255.3	30.2
387391.7	3747302.3	49.1
387419.7	3747369.3	72.6
387456.6	3747455.2	93.5
387471.8	3747496.3	43.8
387483.4	3747538.4	43.6
387498.2	3747631.6	94.4
387534.6	3747840.9	212.4
387550.0	3747944.5	104.8
387557.8	3748042.8	98.7
387559.9	3748166.9	124.1
387553.2	3748278.3	111.6
387542.8	3748376.9	99.1
387517.9	3748523.3	148.5
387496.3	3748654.0	132.5
387458.6	3748954.1	302.5
387414.6	3749350.9	399.3
387378.8	3749635.0	286.3
387296.9	3750312.4	682.3
387242.8	3750772.7	463.5
387187.6	3751240.6	471.1
387138.9	3751654.6	416.8
387086.3	3752129.8	478.1
387032.0	3752553.7	427.3
386979.1	3753006.0	455.5
386929.3	3753425.2	422.1
386841.0	3754171.7	751.6
386743.8	3754991.5	825.6
386645.6	3755819.2	833.5
386534.0	3756634.5	822.9
386472.5	3757001.4	372.0
386402.7	3757398.4	403.1
386321.2	3757876.0	484.5
386223.1	3758448.8	581.2
386134.2	3758966.8	525.6
386051.7	3759445.2	485.4
385981.0	3759878.9	439.5
385937.7	3760164.5	288.8
385874.9	3760536.5	377.2
385793.7	3761009.4	479.8
385718.3	3761446.0	443.0
385676.2	3761702.5	259.9
385661.0	3761858.9	157.2
385638.8	3762266.1	407.8

385420.2	3739288.8	165.2
385408.7	3739563.5	275.0
385394.1	3739829.3	266.2
385387.2	3739898.0	69.0
385371.7	3739950.3	54.6
385352.9	3739989.6	43.5
385319.0	3740042.5	62.8
385251.1	3740146.4	124.1
385218.9	3740200.9	63.3
385202.6	3740238.3	40.8
385194.1	3740281.9	44.4
385195.1	3740323.5	41.6
385205.5	3740374.0	51.5
385230.6	3740428.1	59.6
385280.8	3740524.7	108.9
385323.8	3740599.9	86.6
385352.1	3740658.7	65.3
385372.4	3740709.9	55.1
385396.0	3740780.8	74.7
385424.7	3740877.2	100.6
385440.1	3740925.9	51.0
385461.6	3741001.7	78.9
385510.0	3741154.4	160.1
385544.4	3741261.0	112.1
385560.3	3741303.6	45.4
385580.5	3741354.0	54.3
385599.7	3741411.0	60.1
385653.8	3741583.5	180.8
385686.2	3741694.4	115.5
385720.9	3741818.6	129.0
385758.9	3741937.4	124.7
385805.4	3742084.1	153.9
385867.4	3742274.2	200.0
385933.4	3742481.6	217.7
385992.2	3742659.3	187.1
386038.5	3742796.6	144.9
386096.8	3742967.3	180.4
386167.1	3743178.0	222.1
386194.7	3743273.1	99.0
386193.6	3743261.5	11.6
386203.2	3743302.1	41.7
386209.7	3743340.5	39.0
386211.6	3743364.3	23.8
386214.2	3743415.3	51.1
386216.0	3743474.3	59.0
386219.3	3743537.4	63.2
386224.0	3743581.1	43.9
386229.3	3743611.1	30.5
386236.2	3743639.4	29.2
386244.5	3743669.1	30.8
386252.5	3743693.3	25.5
386288.2	3743803.0	115.3
386306.2	3743856.0	56.0
386324.3	3743900.2	47.8
386344.5	3743940.7	45.3

385611.3	3762732.6	467.3
385587.9	3763116.4	384.5
385559.3	3763567.8	452.3
385535.8	3764147.2	579.9
385537.1	3764250.7	103.5
385562.8	3764330.2	83.5
385601.0	3764399.5	79.2
385653.2	3764458.6	78.9
385754.7	3764530.5	124.3
385962.9	3764670.0	250.6
386130.1	3764783.1	201.8
386227.5	3764829.6	108.0
386312.1	3764852.1	87.5
386405.2	3764857.5	93.3
386535.0	3764858.4	129.7
386625.0	3764861.0	90.1
386817.9	3764863.3	193.0
387003.0	3764860.6	185.0
387111.0	3764861.6	108.0
387162.7	3764865.7	51.9
387210.1	3764878.4	49.1
387298.1	3764911.4	94.0
387342.4	3764921.1	45.3
387382.2	3764923.7	39.8
387419.8	3764920.1	37.8
387558.5	3764899.6	140.3
387691.3	3764873.4	135.4
387768.8	3764850.3	80.8
387836.5	3764819.1	74.5
387978.0	3764753.3	156.1
388186.5	3764654.9	230.5
388476.9	3764519.2	320.6
388660.5	3764434.7	202.1
388773.2	3764391.3	120.8
388977.6	3764331.9	212.8
389123.2	3764306.6	147.8
389376.9	3764277.1	255.5
389653.1	3764245.7	278.0
389961.4	3764211.0	310.2
390253.3	3764177.0	293.8
390571.6	3764141.0	320.3
390876.4	3764105.7	306.8
391198.4	3764069.3	324.1
391532.6	3764030.3	336.5
391806.4	3764000.5	275.4
392078.6	3763968.1	274.1
392402.9	3763930.2	326.6
392699.7	3763897.1	298.6
392879.0	3763876.8	180.5
393152.5	3763849.2	274.9
393186.7	3763844.9	34.5
393533.1	3763805.0	348.6
393990.5	3763752.5	460.4
394490.6	3763695.0	503.4
395003.1	3763636.7	515.9

386366.4	3743977.9	43.1
386390.5	3744013.6	43.1
386445.3	3744096.2	99.1
386470.5	3744139.6	50.2
386492.0	3744184.7	49.9
386510.2	3744236.0	54.5
386537.9	3744325.3	93.5
386575.9	3744443.6	124.3
386653.2	3744685.3	253.7
386720.1	3744892.7	218.0
386785.3	3745094.8	212.3
386840.1	3745264.5	178.3
386913.0	3745493.7	240.5
386969.1	3745676.8	191.5
387010.6	3745805.2	134.9
387076.7	3746000.3	206.0
387126.8	3746150.3	158.1
387172.9	3746295.2	152.1
387223.5	3746450.2	163.0
387286.6	3746698.2	255.9

395471.8	3763580.4	472.0
395950.0	3763524.0	481.6

Source: ARB 2016 Vision 2.1 Locomotive Module. Current Control Programs Scenario. Table "b_TierDist_Sc0".

Line Haul Locomotive Projected Fleet Mix in the South Coast Air Basin

CY	Tier	Tier_Share	Air Basin
1990	Pre-Tier	100.0%	SC
1990	Tier 0	0.0%	SC
1990	Tier 0r	0.0%	SC
1990	Tier 1	0.0%	SC
1990	Tier 1r	0.0%	SC
1990	Tier 2	0.0%	SC
1990	Tier 2r	0.0%	SC
1990	Tier 3	0.0%	SC
1990	Tier 4	0.0%	SC
1990	Tier4+AT	0.0%	SC
1990	LNG	0.0%	SC
1990	Catenary	0.0%	SC
1990	Battery	0.0%	SC
1990	FuelCell	0.0%	SC
1990	MagLev	0.0%	SC
1991	Pre-Tier	100.0%	SC
1991	Tier 0	0.0%	SC
1991	Tier 0r	0.0%	SC
1991	Tier 1	0.0%	SC
1991	Tier 1r	0.0%	SC
1991	Tier 2	0.0%	SC
1991	Tier 2r	0.0%	SC
1991	Tier 3	0.0%	SC
1991	Tier 4	0.0%	SC
1991	Tier4+AT	0.0%	SC
1991	LNG	0.0%	SC
1991	Catenary	0.0%	SC
1991	Battery	0.0%	SC
1991	FuelCell	0.0%	SC
1991	MagLev	0.0%	SC
1992	Pre-Tier	100.0%	SC
1992	Tier 0	0.0%	SC
1992	Tier 0r	0.0%	SC
1992	Tier 1	0.0%	SC
1992	Tier 1r	0.0%	SC
1992	Tier 2	0.0%	SC

2019	Catenary	0.0%	SC
2019	Battery	0.0%	SC
2019	FuelCell	0.0%	SC
2019	MagLev	0.0%	SC
2020	Pre-Tier	0.0%	SC
2020	Tier 0	0.0%	SC
2020	Tier 0r	33.9%	SC
2020	Tier 1	0.0%	SC
2020	Tier 1r	11.9%	SC
2020	Tier 2	0.0%	SC
2020	Tier 2r	20.6%	SC
2020	Tier 3	17.7%	SC
2020	Tier 4	15.9%	SC
2020	Tier4+AT	0.0%	SC
2020	LNG	0.0%	SC
2020	Catenary	0.0%	SC
2020	Battery	0.0%	SC
2020	FuelCell	0.0%	SC
2020	MagLev	0.0%	SC
2021	Pre-Tier	0.0%	SC
2021	Tier 0	0.0%	SC
2021	Tier 0r	30.5%	SC
2021	Tier 1	0.0%	SC
2021	Tier 1r	11.8%	SC
2021	Tier 2	0.0%	SC
2021	Tier 2r	20.3%	SC
2021	Tier 3	17.5%	SC
2021	Tier 4	19.9%	SC
2021	Tier4+AT	0.0%	SC
2021	LNG	0.0%	SC
2021	Catenary	0.0%	SC
2021	Battery	0.0%	SC
2021	FuelCell	0.0%	SC
2021	MagLev	0.0%	SC
2022	Pre-Tier	0.0%	SC
2022	Tier 0	0.0%	SC
2022	Tier 0r	27.3%	SC
2022	Tier 1	0.0%	SC
2022	Tier 1r	11.6%	SC
2022	Tier 2	0.0%	SC
2022	Tier 2r	20.1%	SC

2038	FuelCell	0.0%	SC
2038	MagLev	0.0%	SC
2039	Pre-Tier	0.0%	SC
2039	Tier 0	0.0%	SC
2039	Tier 0r	0.4%	SC
2039	Tier 1	0.0%	SC
2039	Tier 1r	1.8%	SC
2039	Tier 2	0.0%	SC
2039	Tier 2r	6.3%	SC
2039	Tier 3	9.9%	SC
2039	Tier 4	81.6%	SC
2039	Tier4+AT	0.0%	SC
2039	LNG	0.0%	SC
2039	Catenary	0.0%	SC
2039	Battery	0.0%	SC
2039	FuelCell	0.0%	SC
2039	MagLev	0.0%	SC
2040	Pre-Tier	0.0%	SC
2040	Tier 0	0.0%	SC
2040	Tier 0r	0.1%	SC
2040	Tier 1	0.0%	SC
2040	Tier 1r	1.3%	SC
2040	Tier 2	0.0%	SC
2040	Tier 2r	5.5%	SC
2040	Tier 3	9.1%	SC
2040	Tier 4	84.0%	SC
2040	Tier4+AT	0.0%	SC
2040	LNG	0.0%	SC
2040	Catenary	0.0%	SC
2040	Battery	0.0%	SC
2040	FuelCell	0.0%	SC
2040	MagLev	0.0%	SC
2041	Pre-Tier	0.0%	SC
2041	Tier 0	0.0%	SC
2041	Tier 0r	0.0%	SC
2041	Tier 1	0.0%	SC
2041	Tier 1r	0.9%	SC
2041	Tier 2	0.0%	SC
2041	Tier 2r	4.6%	SC
2041	Tier 3	8.3%	SC
2041	Tier 4	86.3%	SC

2041	Tier4+AT	0.0%	SC
2041	LNG	0.0%	SC
2041	Catenary	0.0%	SC
2041	Battery	0.0%	SC
2041	FuelCell	0.0%	SC
2041	MagLev	0.0%	SC
2042	Pre-Tier	0.0%	SC
2042	Tier 0	0.0%	SC
2042	Tier 0r	0.0%	SC
2042	Tier 1	0.0%	SC
2042	Tier 1r	0.4%	SC
2042	Tier 2	0.0%	SC
2042	Tier 2r	3.8%	SC
2042	Tier 3	7.5%	SC
2042	Tier 4	88.3%	SC
2042	Tier4+AT	0.0%	SC
2042	LNG	0.0%	SC
2042	Catenary	0.0%	SC
2042	Battery	0.0%	SC
2042	FuelCell	0.0%	SC
2042	MagLev	0.0%	SC
2043	Pre-Tier	0.0%	SC
2043	Tier 0	0.0%	SC
2043	Tier 0r	0.0%	SC
2043	Tier 1	0.0%	SC
2043	Tier 1r	0.1%	SC
2043	Tier 2	0.0%	SC
2043	Tier 2r	3.0%	SC
2043	Tier 3	6.7%	SC
2043	Tier 4	90.1%	SC
2043	Tier4+AT	0.0%	SC
2043	LNG	0.0%	SC
2043	Catenary	0.0%	SC
2043	Battery	0.0%	SC
2043	FuelCell	0.0%	SC
2043	MagLev	0.0%	SC
2044	Pre-Tier	0.0%	SC
2044	Tier 0	0.0%	SC
2044	Tier 0r	0.0%	SC
2044	Tier 1	0.0%	SC
2044	Tier 1r	0.0%	SC

Assumptions Used in the Traffic Emission Calculations

Parameter	Value	Unit of Measure	Reference
Global Warming Potential, CO2	1	(unitless)	EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, April 2017
Global Warming Potential, CH4	25	(unitless)	EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, April 2017
Global Warming Potential, N2O	298	(unitless)	EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015, April 2017
Ratio Annual/Peak Day for Trucks, 2021 & 2041	247.0	(unitless)	China Shipping Draft Supplemental EIR, 2017. Appendix B1, Tables B1-148 and B1-244. Assume the peaking factors in 2021 and 2041 are the same as years 2023 and 2045. Confirmed by Ramesh Thammiraju/CSI, telephone conversation, 9/12/17.
Ratio 2021/2041 APMT Truck VMT	0.366	(unitless)	Email from Kerry Cartwright/POLA, 9/21/17.

Scenario	CY	TimePeriod	SumOfEmis_ ROG	SumOfEmis_ CO	SumOfEmis_ NOx	SumOfEmis_ PM10EX	SumOfEmis_ PM25EX	SumOfEmis_ PM10TW	SumOfEmis_ PM10BW	SumOfEmis_ PM25TW	SumOfEmis_ PM25BW	SumOfEmis_ SOx	SumOfEmis_ CO2	SumOfEmis_ CH4	SumOfEmis_ N2O	SumOfEmis_ DPM	SumOfEmis_ PM10Dust	SumOfEmis_ PM25Dust
NoProj	2021	AM	2931.20152	10847.5227	164829.147	864.196445	826.811689	826.125763	1416.80568	206.531441	607.202435	384.888931	37853664.94	159.756814	1444.14625	796.875542	1333.08434	200.020966
NoProj	2021	MD	7171.05026	26578.408	392167.727	2050.20238	1961.51153	1956.36729	3355.1699	489.091822	1437.92996	911.464269	90136615.43	393.391146	3419.91573	1890.49162	3161.35473	474.341502
NoProj	2021	NTEV	4474.03673	16553.1533	270655.233	1428.7199	1366.91411	1376.3086	2360.36925	344.07715	1011.58682	641.217075	62126035.31	240.876438	2405.91808	1317.42262	2232.82726	335.021763
NoProj	2021	PM	3136.53349	11631.9821	170768.281	892.327336	853.725651	851.333367	1460.03672	212.833342	625.730024	396.63306	39251777.6	172.3233	1488.21154	822.815037	1378.59651	206.849783
NoProj	2041	AM	9312.16589	128550.958	235968.369	445.214792	425.954997	2247.50016	3854.46277	561.87504	1651.91262	863.278082	110491516.1	1271.11673	3428.95338	410.53256	3638.50798	545.935361
NoProj	2041	MD	25437.2384	348766.221	638352.202	1100.68092	1053.06595	5322.35646	9127.84133	1330.58912	3911.932	2044.34855	272148996.6	3444.78824	8120.18282	1014.93788	8628.57215	1294.66328
NoProj	2041	NTEV	5919.8026	53440.945	95950.4742	619.50301	592.703584	3744.28923	6421.45603	936.072307	2752.05258	1438.2036	151152333.1	488.923095	5712.56609	571.243726	6094.25792	914.405279
NoProj	2041	PM	10977.0694	141229.332	263851.446	478.627121	457.921924	2316.07821	3972.07413	579.019552	1702.31748	889.619316	117098058.1	1381.46223	3533.58115	441.342069	3762.72848	564.57387
Proj	2021	AM	2743.83724	10145.7134	155608.449	816.626395	781.299499	780.95189	1339.33249	195.237972	573.999639	363.842591	35727020.81	149.157	1365.17804	753.011199	1253.56809	188.09005
Proj	2021	MD	6709.43734	24842.4252	370016.909	1936.35563	1852.58975	1848.30635	3169.84539	462.076587	1358.50517	861.119078	85022634.41	367.032777	3231.01495	1785.51353	2969.96482	445.624643
Proj	2021	NTEV	4204.87664	15534.3609	257741.422	1362.48822	1303.54759	1313.05829	2251.89497	328.264573	965.097843	611.748991	59139706.79	225.356618	2295.35053	1256.35039	2118.48838	317.86593
Proj	2021	PM	2971.48908	11011.494	162885.393	851.824193	814.974656	812.927898	1394.17134	203.231974	597.502005	378.740095	37432275.15	162.899127	1421.07513	785.467089	1309.3811	196.464444
Proj	2041	AM	8648.39132	118627.11	217747.712	418.896645	400.775362	2124.60327	3643.69461	531.150817	1561.5834	816.072661	103888390.5	1171.91599	3241.45274	386.264596	3421.47707	513.371231
Proj	2041	MD	23614.0533	320981.219	584809.313	1035.37393	990.584115	5028.37341	8623.66039	1257.09335	3695.85445	1931.42792	255631839.2	3166.3754	7671.66041	954.718303	8106.1943	1216.28375
Proj	2041	NTEV	5508.09504	49112.7385	89517.9752	588.935442	563.458356	3572.21485	6126.34846	893.053712	2625.57791	1372.10882	143703726	448.041164	5450.03662	543.057371	5782.18245	867.580306
Proj	2041	PM	10271.65	131320.811	244089.513	454.610731	434.944472	2211.59497	3792.88537	552.898742	1625.5223	849.486686	111125290.8	1283.29838	3374.17375	419.196555	3573.81258	536.228222

Source: Exported from Microsoft Access.