

**Air Quality and GHG Emissions -
Construction and Operation Tables**

Appendix B1

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Table B1.1. Construction Schedule - Proposed Project

Task ID	Proposed Project	Start Date	End Date	Duration (days)	Hr/Day
1					
2					
3	Installation of VDU - Shell	7/2/2018	11/2/2018	116	
4	Construct Piping Trenches	7/2/2018	8/24/2018	40	8
5	Install DSU and VDU Equipment	7/23/2018	8/13/2018	16	8
6	Install DSU and VDU Piping, Controls and Elec	8/13/2018	10/19/2018	50	8
7	Testing and Commissioning	10/22/2018	11/2/2018	10	8
8	Pre Demo Activities for B168 Demolition- Shell				
9	Decommission Berth 168				
10	Revise Fire Water Berth 168	7/30/2018	9/7/2018	30	8
11	Electrical Supply to Berth 169	9/24/2018	10/22/2018	21	8
12	Revise Elec & Utilities on Berth 169	10/22/2018	11/19/2018	21	8
13	Demo Topsides Berth 168	11/19/2018	12/3/2018	11	8
14	Site Preparation Activities				
15	Demo Product Piping, Elec, and Utilities	7/30/2018	11/16/2018	80	8
16	Install Temp Jet Line	10/15/2018	11/16/2018	25	8
17	Demo Supports and Paving	11/19/2018	11/30/2018	10	8
18	Berth 168 Demolition and Improvements - Port				
19	Demolition of Berth 168	12/3/2018	3/20/2019	78	8
20	Construct Berth 168				
21	Pile Driving	1/14/2019	1/10/2020	260	8
22	Deck Construction and Dolphin Construction	1/14/2019	5/14/2019	87	8
23	Trestle and Catwalk Construction	5/15/2019	11/26/2019	140	8
24	Dredging @ Berth 168	11/29/2019	1/10/2020	31	8
25	Shell MOTEMS Construction Activities				
26	Shoreside Improvements	1/13/2020	1/24/2020	10	8
27	Pipe Supports				
28	Pile Installation	7/15/2019	5/15/2020	220	8
29	Pile Cap and Manifold Support Structures	10/4/2019	10/7/2019	30	8
30	Repair HDPE Below Grade Wall	10/7/2019	10/18/2019	10	8
31	Pave and Prep Area	10/7/2019	10/18/2019	10	8
32	Product Piping				
33	Product Piping Above Grade	10/21/2019	11/15/2019	20	8
34	Elec., Utilities, Fire Water, Controls	11/18/2019	2/7/2020	60	8
35	Access Platforms	1/27/2020	3/6/2020	30	8
36	Topside Improvements				
37	Install Gangway, Loading Arms, DSU and VDU , & Dock House	1/13/2020	1/31/2020	15	8
38	Product Piping	12/2/2019	1/10/2020	30	8
39	Elec., Utilities, Fire Water, Controls	2/10/2020	2/21/2020	10	8
40	Testing and Commissioning	1/13/2020	3/20/2020	50	8
41	Shell Decommissioning Berth 169				
42	Remove Temp Jet Line	3/23/2020	5/15/2020	40	8
43	Decommission Berth 169	5/18/2020	5/29/2020	10	8
44	Demo Topsides Berth 169	5/18/2020	5/29/2020	10	8
45	POLA Demolition Activities Berth 169				
46	Demolition of Berth 169	6/8/2020	6/19/2020	10	8
47	Pile Driving	6/15/2020	9/13/2020	65	8
48	Catwalk Construction	7/27/2020	8/20/2020	19	8
49	Revise Fire Water Berth 169	8/21/2020	11/20/2020	66	8
50	Dredging @ Berth 169	11/21/2020	12/6/2020	10	8
51	Platform 2 Construction at Berth 169				
52	Pile Driving	10/5/2020	10/16/2020	10	8
53	Platform Construction	1/1/2021	8/7/2023	677	8
54	Trestle and Catwalk Construction	1/1/2021	5/3/2021	87	8
55	Topside Equipment Replacement				
56	Install Gangway, Loading Arms, DSU and VDU , & Dock House	5/4/2021	11/15/2021	140	8
57	Product Piping	11/16/2021	12/28/2021	31	8
58	Elec., Utilities, Fire Water, Controls			0	8
59	Testing and Commissioning	1/15/2022	2/25/2022	30	8
60	Clean-Up Dredging	3/25/2022	4/7/2022	10	8
61	Source Control Program				
62	Source Control Program	2/27/2022	5/6/2022	50	8
		5/7/2022	7/3/2022	40	8
		8/1/2022	8/12/2022	10	8
		7/2/2018	8/7/2023	225	8

Table B1.2. Construction Schedule - Alternative

Task ID	Proposed Project	Start Date	End Date	Duration (days)	Hr/Day
1					
2					
3	Installation of VDU - Shell	7/2/2018	11/2/2018	116	
4	Construct Piping Trenches	7/2/2018	8/24/2018	40	8
5	Install DSU and VDU Equipment	7/23/2018	8/13/2018	16	8
6	Install DSU and VDU Piping, Controls and Elec	8/13/2018	10/19/2018	50	8
7	Testing and Commissioning	10/22/2018	11/2/2018	10	8
8	Pre Demo Activities for B168 Demolition- Shell				
9	Decommission Berth 168				
10	Revise Fire Water Berth 168	7/30/2018	9/7/2018	30	8
11	Electrical Supply to Berth 169	9/24/2018	10/22/2018	21	8
12	Revise Elec & Utilities on Berth 169	10/22/2018	11/19/2018	21	8
13	Demo Topsides Berth 168	11/19/2018	12/3/2018	11	8
14	Site Preparation Activities				
15	Demo Product Piping, Elec, and Utilities	7/30/2018	11/16/2018	80	8
16	Install Temp Jet Line	10/15/2018	11/16/2018	25	8
17	Demo Supports and Paving	11/19/2018	11/30/2018	10	8
18	Berth 168 Demolition and Improvements - Port				
19	Demolition of Berth 168	12/3/2018	3/20/2019	78	8
20	Construct Berth 168				
21	Pile Driving	1/14/2019	5/14/2019	87	8
22	Deck Construction and Dolphin Construction	5/15/2019	11/26/2019	140	8
23	Trestle and Catwalk Construction	11/29/2019	1/10/2020	31	8
24	Dredging @ Berth 168	1/13/2020	1/24/2020	10	8
25	Shell MOTEMS Construction Activities				
26	Shoreside Improvements				
27	Pipe Supports				
28	Pile Installation	7/15/2019	10/4/2019	60	8
29	Pile Cap and Manifold Support Structures	10/7/2019	11/15/2019	30	8
30	Repair HDPE Below Grade Wall	10/7/2019	10/18/2019	10	8
31	Pave and Prep Area	10/21/2019	11/15/2019	20	8
32	Product Piping				
33	Product Piping Above Grade	11/18/2019	2/7/2020	60	8
34	Elec., Utilities, Fire Water, Controls	1/27/2020	3/6/2020	30	8
35	Access Platforms	1/13/2020	1/31/2020	15	8
36	Topside Improvements				
37	Install Gangway, Loading Arms, DSU and VDU , & Dock House	12/2/2019	1/10/2020	30	8
38	Product Piping	2/10/2020	2/21/2020	10	8
39	Elec., Utilities, Fire Water, Controls	1/13/2020	3/20/2020	50	8
40	Testing and Commissioning	3/23/2020	5/15/2020	40	8
41	Shell Decommissioning Berth 169				
42	Remove Temp Jet Line	5/18/2020	5/29/2020	10	8
43	Decommission Berth 169	5/18/2020	5/29/2020	10	8
44	Demo Topsides Berth 169	6/8/2020	6/19/2020	10	8
45	POLA Demolition Activities Berth 169				
46	Demolition of Berth 169	6/15/2020	9/13/2020	65	8
47	Pile Driving	7/27/2020	8/20/2020	19	8
48	Catwalk Construction	8/21/2020	11/20/2020	66	8
49	Revise Fire Water Berth 169	11/21/2020	12/6/2020	10	8
50	Dredging @ Berth 169	10/5/2020	10/16/2020	10	8
51	Platform 2 Construction at Berth 169				
52	Pile Driving				
53	Platform Construction				
54	Trestle and Catwalk Construction				
55	Topside Equipment Replacement				
56	Install Gangway, Loading Arms, DSU and VDU , & Dock House				
57	Product Piping				
58	Elec., Utilities, Fire Water, Controls				
59	Testing and Commissioning				
60	Clean-Up Dredging				
61	Source Control Program				
62	Source Control Program	7/2/2018	8/7/2023	225	8

Table B1.3. Construction Schedule - No Project

Task ID	Proposed Project	Start Date	End Date	Duration (days)	Hr/Day
1	No construction; no demolition				

Legend:

Information provided by LAHD
Information assumed by iLanco and Envicraft

Table B1.4. Construction Equipment - Activity

Task ID	Task Name	Equipment	Quantity	Average Engine RunTime (hr/day)	Peak Engine RunTime (hr/day)	Annual (hr/yr)	Days
3	Installation of VDU - Shell						
4	Construct Pi Loader/Backhoe (3 days)		1	8	8	24	3
4	Forklift/Cranes (2 weeks)		1	8	8	80	10
4	Dump Trucks (4hrs./Day EA.)		1	4	4	4	1
5	Install DSU a Forklift/Cranes (4hrs./Day)		1	4	4	64	16
	Forklift/Cranes (4hrs./Day						
6	Install DSU a EA.)		2	4	4	200	50
6	400 Amp Diesel Welders (3hr		2	3	3	150	50
7	Testing and Welding Unit (3hrs./Week)		1	1	1	10	10
8	Pre Demo Activities for B168 Demolition- Shell						
9	Decommission Berth 168						
10	Revise Fire V Forklift/Cranes (4hrs./Day EA		4	4	4	120	30
10	Welding Units (3hrs./Day EA.		4	1	1	30	30
11	Electrical Su Forklift/Crane (3hrs./Day)		2	3	3	63	21
11	Welding Unit (4hrs./Week)		2	1	1	21	21
12	Revise Elec & Forklift/Crane (3hrs./Day)		2	3	3	63	21
12	Welding Unit (4hrs./Week)		2	1	1	21	21
13	Demo Topsi Forklift/Cranes (4hrs./Day EA		4	4	4	44	11
13	Torch (3hrs./Day)		2	3	3	33	11
14	Site Preparation Activities						
15	Demo Produ Forklift/Cranes (4hrs./Day EA		4	4	4	320	80
15	Dump Trucks (8hrs./Day EA.		2	8	8	16	2
15	Torch (3hrs./Day)		2	3	3	240	80
16	Install Temp Forklift/Cranes (4hrs./Day)		2	4	4	100	25
16	400 Amp Diesel Welders (3hr		2	1	1	25	25
17	Demo Suppc Loader/Backhoe (4hrs./Day)		2	4	4	40	10
17	Forklift/Crane (4hrs./Day)		2	4	4	40	10
18	Berth 168 Demolition and Improvements - Port						
19	Demolition c Aerial Lifts		1	8	8	624	78
19	Cranes		1	8	8	624	78
19	Excavators		1	8	8	624	78
19	Generator Sets		1	8	8	624	78
19	Tugboats Propulsion		1	8	8	624	78
19	Tugboats Auxiliary		1	8	8	624	78
20	Construct Berth 168						
21	Pile Driving Aerial Lifts		1	8	8	696	87
21	Cranes		1	8	8	696	87
21	Forklifts		1	8	8	696	87
21	Generator Sets		1	8	8	696	87
21	Tugboats Propulsion		1	2	2	174	87
21	Tugboats Auxiliary		1	8	8	696	87
22	Deck Constr Aerial Lifts		1	8	8	1120	140
22	Cranes		1	8	8	1120	140
22	Forklifts		1	8	8	1120	140
22	Generator Sets		1	8	8	1120	140
22	Tugboats Propulsion		1	4	4	560	140
22	Tugboats Auxiliary		1	8	8	1120	140
23	Trestle and (Aerial Lifts		1	8	8	248	31

Task ID	Task Name	Equipment	Quantity	Average Engine RunTime (hr/day)	Peak Engine RunTime (hr/day)	Annual (hr/yr)	Days
23		Concrete Pump Trucks	1	8	8	248	31
23		Cranes	1	8	8	248	31
23		Forklifts	1	8	8	248	31
23		Generator Sets	1	8	8	248	31
23		Tugboats Propulsion	1	4	4	124	31
23		Tugboats Auxiliary	1	8	8	248	31
24	Dredging @	Derrick Barge Dredging Equip	1	8	8	80	10
24		Flat Barge	1	8	8	80	10
24		Tugboats Propulsion	1	4	4	40	10
24		Tugboats Auxiliary	1	8	8	80	10
25	Shell MOTEMS Construction Activities						
26	Shoreside Improvements						
27	Pipe Supports						
28	Pile Installat	Forklift/Cranes (4hrs./Day EA	4	4	4	240	60
28		Small Cranes (8hrs./Day - 2 D	2	8	8	16	2
28		Manitowoc 18000 Crane Full	1	8	8	480	60
28		Diesel Power Unit for Ape M	1	8	8	480	60
28		Workboats Propulsion	2	2	2	120	60
28		Workboats Auxiliary	2	8	8	480	60
28		400 Amp Diesel Welders	2	8	8	480	60
29	Pile Cap and	Forklift/Crane (3hrs./Day)	2	3	3	90	30
29		Welding Unit (4hrs./Day)	2	4	4	120	30
30	Repair HDPE	Loader/Backhoe (4hrs./Day-	2	4	4	24	6
30		Forklift/Crane (4hrs./Day- 6 I	2	4	4	24	6
31	Pave and Pre	Loader/Backhoe (4hrs./Day)	2	4	4	80	20
31		Forklift/Crane (4hrs./Day)	2	4	4	80	20
31		Dump Trucks (8hrs./Day EA.	4	8	8	40	5
32	Product Piping						
33	Product Pipi	Forklift/Cranes (4hrs./Day EA	6	4	4	240	60
33		400 Amp Diesel Welders (3hr	6	3	3	180	60
34	Elec., Utilitie	Forklift/Crane (3hrs./Day)	2	4	4	120	30
34		400 Amp Diesel Welders (4hr	2	1	1	30	30
35	Access Platf	Forklift/Crane (3hrs./Day)	2	3	3	45	15
35		400 Amp Diesel Welders (4hr	2	1	1	15	15
36	Topside Improvements						
37	Install Gang	Forklift/Crane (3hrs./Day)	2	3	3	90	30
37		Welding Unit (4hrs./Week)	2	4	4	120	30
37		Crane on Barge (8hrs./Day)	2	8	8	240	30
37		Support Barge (8hrs./Day)	2	8	8	240	30
37		Tugboats Propulsion	2	4	4	48	12
37		Tugboats Auxiliary	2	4	4	48	12
37		Workboats Propulsion	2	4	4	120	30
37		Workboats Auxiliary	2	4	4	120	30
38	Product Pipi	Forklift/Cranes (4hrs./Day EA	4	4	4	40	10
38		Welding Units (3hrs./Day EA.	4	3	3	30	10
39	Elec., Utilitie	Forklift/Crane (3hrs./Day)	2	4	4	200	50
39		Welding Unit (4hrs./Week)	2	1	1	50	50
40	Testing and	(2) Forklift/Crane (10hrs./We	2	2	2	80	40
40		(2) Welding Unit (3hrs./Weel	2	1	1	40	40
41	Shell Decommissioning Berth 169						
42	Remove Ten	(2) Forklift/Cranes (4hrs./Day)	2	4	4	40	10
42		(2) Torch (3hrs./Day)	2	3	3	30	10
43	Decommissi	(1) Cranes	1	8	8	80	10

Task ID	Task Name	Equipment	Quantity	Average Engine RunTime (hr/day)	Peak Engine RunTime (hr/day)	Annual (hr/yr)	Days
43		(1) Excavators	1	8	8	80	10
44	Demo Topside	(4) Forklift/Cranes (4hrs./Day)	4	4	4	40	10
44		(2) Torch (3hrs./Day)	2	3	3	30	10
45	POLA Demolition Activities Berth 169						
46	Demolition	(1) Aerial Lifts	1	8	8	520	65
46		(1) Cranes	1	8	8	520	65
46		(1) Excavators	1	8	8	520	65
46		(1) Generator Sets	1	8	8	520	65
46		Tugboats Propulsion	1	4	4	260	65
46		Tugboats Auxiliary	1	4	4	260	65
47	Pile Driving	(1) Aerial Lifts	1	8	8	152	19
47		(1) Cranes	1	8	8	152	19
47		(1) Diesel Hammer	1	8	8	152	19
47		(1) Generator Sets	1	8	8	152	19
47		Tugboats Propulsion	1	2	2	38	19
47		Tugboats Auxiliary	1	8	8	152	19
47		Workboats Propulsion	1	2	2	38	19
47		Workboats Auxiliary	1	8	8	152	19
48	Catwalk Construction	(1) Aerial Lifts	1	8	8	528	66
48		(1) Concrete Pump Trucks	1	8	8	528	66
48		(1) Cranes	1	8	8	528	66
48		(1) Forklifts	1	8	8	528	66
48		(1) Generator Sets	1	8	8	528	66
48		Tugboats Propulsion	1	4	4	264	66
48		Tugboats Auxiliary	1	4	4	264	66
49	Revise Fire V	(4) Forklift/Cranes (4hrs./Day)	4	4	4	40	10
49		(4) Welding Units (3hrs./Day)	4	3	3	30	10
50	Dredging @	(1) Derrick Barge Dredging Equipment	1	8	8	80	10
50		(1) Flat Barge	1	8	8	80	10
50		Tugboats Propulsion	1	4	4	40	10
50		Tugboats Auxiliary	1	8	8	80	10
51	Platform 2 Construction at Berth 169						
52	Pile Driving	Aerial Lifts	1	8	8	696	87
52		Cranes	1	8	8	696	87
52		Forklifts	1	8	8	696	87
52		Generator Sets	1	8	8	696	87
52		Tugboats Propulsion	1	2	2	174	87
52		Tugboats Auxiliary	1	8	8	696	87
53	Platform Construction	Aerial Lifts	1	8	8	1120	140
53		Cranes	1	8	8	1120	140
53		Forklifts	1	8	8	1120	140
53		Generator Sets	1	8	8	1120	140
53		Tugboats Propulsion	1	4	4	560	140
53		Tugboats Auxiliary	1	4	4	560	140
54	Trestle and	Aerial Lifts	1	8	8	248	31
54		Concrete Pump Trucks	1	8	8	248	31
54		Cranes	1	8	8	248	31
54		Forklifts	1	8	8	248	31
54		Generator Sets	1	8	8	248	31
54		Tugboats Propulsion	1	4	4	124	31
54		Tugboats Auxiliary	1	4	4	124	31
55	Topside Equipment Replacement						
56	Install Gangway	Forklift/Crane (3hrs./Day)	2	3	3	90	30

Task ID	Task Name	Equipment	Quantity	Average Engine RunTime (hr/day)	Peak Engine RunTime (hr/day)	Annual (hr/yr)	Days
56		Welding Unit (4hrs./Week)	2	4	4	120	30
56		Crane on Barge (8hrs./Day)	2	8	8	240	30
56		Support Barge (8hrs./Day)	2	8	8	240	30
56		Tugboats Propulsion	2	4	4	48	12
56		Tugboats Auxiliary	2	4	4	48	12
56		Workboats Propulsion	2	4	4	120	30
56		Workboats Auxiliary	2	4	4	120	30
57	Product Pipi	Forklift/Cranes (4hrs./Day EA)	4	4	4	40	10
57		Welding Units (3hrs./Day EA.	4	3	3	30	10
58	Elec., Utilitie	Forklift/Crane (3hrs./Day)	2	4	4	200	50
58		Welding Unit (4hrs./Week)	2	1	1	50	50
59	Testing and	(2) Forklift/Crane (10hrs./We	2	2	2	80	40
59		(2) Welding Unit (3hrs./Weel	2	1	1	40	40
60	Clean-Up Dr	(1) Derrick Barge Dredging Ec	1	8	8	80	10
60		(1) Flat Barge	1	8	8	80	10
60		Tugboats Propulsion	1	4	4	40	10
60		Tugboats Auxiliary	1	8	8	80	10
61	Source Control Program						
62	Source Cont	(2) Forklift/Cranes (4hrs./Day)	2	4	4	900	225
62		(4) Welding Units (3hrs./Day	4	3	3	675	225
62		(2) Manlifts (3hrs./Day EA.)	2	3	3	675	225
62		(2) Torch (3hrs./Day)	2	3	3	675	225
62		(2) Dump Trailer Haulers (3h	2	3	3	675	225

Table B1.5. Construction Equipment Characteristics

Equipment	ARB		LAHD LF	LF used in Calculations	CalEEMod Horsepower	LAHD Horsepower	HP used in Calculations (kW for tugboats)	EMFAC2014 Category
	OFFROAD2011 LF	CalEEMod LF						
Offroad2011 Equipment								
A/C Tug Narrow Body	0.536			0.54			0	
A/C Tug Wide Body	0.536			0.54			0	
Aerial Lifts	0.3082	0.31		0.31	63		63	
Baggage Tug	0.3685			0.37			0	
Belt Loader	0.335			0.34			0	
Bobtail	0.3685			0.37			0	
Bore/Drill Rigs	0.536	0.5		0.54	206		206	
Cargo Loader	0.335			0.34			0	
Cargo Tractor	0.3618			0.36			0	
Cement and Mortar Mixers		0.56		0.56	9		9	
Compressors		0.48		0.48	78		78	
Concrete/Industrial Saws		0.73		0.73	81		81	
Cranes	0.2881	0.29		0.29	226		226	
Crawler Tractors	0.4288	0.43		0.43	208		208	
Crushing/Proc. Equipment		0.78		0.78	85		85	
Drill Rig (Mobile)	0.5025			0.50			0	
Dumpers/Tenders		0.38		0.38	16		16	
Excavators	0.3819	0.38		0.38	163		163	
Forklift (GSE)	0.201			0.20			0	
Forklifts	0.201	0.2		0.20	89		89	
Generator Sets		0.74		0.74	84		84	
Graders	0.4087	0.41		0.41	175		175	
Lift (GSE)	0.335	0.31		0.34	63		63	
Off-Highway Tractors	0.4355	0.44		0.44	123		123	
Off-Highway Trucks	0.3819	0.38		0.38	400		400	
Other Construction Equipment	0.4154	0.42		0.42	172		172	
Other General Industrial Equipment	0.3417	0.34		0.34	88		88	
Other GSE	0.335			0.34			0	
Other Material Handling Equipment	0.3953	0.4		0.40	167		167	
Passenger Stand	0.3953			0.40			0	
Pavers	0.4154	0.42		0.42	126		126	
Paving Equipment	0.3551	0.36		0.36	131		131	
Plate Compactors		0.43		0.43	8		8	
Pressure Washers		0.3		0.30	13		13	
Pumps		0.74		0.74	84		84	
Rollers	0.3752	0.38		0.38	81		81	
Rough Terrain Forklifts	0.402	0.4		0.40	100		100	
Rubber Tired Dozers	0.3953	0.4		0.40	255		255	
Rubber Tired Loaders	0.3618	0.36		0.36	200		200	
Scrapers	0.4824	0.48		0.48	362		362	
Signal Boards		0.82		0.82	6		6	
Skid Steer Loaders	0.3685	0.37		0.37	65		65	
Surfacing Equipment	0.3015	0.3		0.30	254		254	
Sweepers/Scrubbers	0.4556	0.46		0.46	64		64	
Tractors/Loaders/Backhoes	0.3685	0.37		0.37	98		98	
Trenchers	0.5025	0.5		0.50	81		81	
Welders		0.45		0.45	46		46	
Workover Rig (Mobile)	0.5025			0.50			0	

Equipment	ARB		LAHD LF	LF used in Calculations	CalEEMod Horsepower	LAHD Horsepower	HP used in Calculations (kW for tugboats)	EMFAC2014 Category
	OFFROAD2011 LF	CalEEMod LF						
Additional Landside Equipment								
Diesel Hammers	0.4154	0.42		0.42		575	575	
Marine Equipment								
Derrick Barge Dredging Equipment	0.4154	0.42	0.49	0.49	172	1369	1369	
Electric Dredge Motor			0.49	0.49		1369	1369	
Flat Barge	0.2881	0.29		0.29		300	300	
Tugboats Propulsion			0.31	0.31			579	
Tugboats Auxiliary			0.43	0.43			48	
Workboats Propulsion			0.38	0.38			377	
Workboats Auxiliary			0.32	0.32			51	
Onsite Vehicles								
Concrete Pump Trucks				0.38			400	
On-Road Vehicles - EMFAC2014								
Haul/Delivery Truck								T6 Instate Construction Heavy
Support Truck								MDV
Worker Vehicles								LDA-LDT2

Dredging Equipment	HP	LF
Derrick barge crane hoist	564	0.31
Derrick barge deck winch	238	0.31
Generator large	432	0.75
Generator small	135	0.75
Total HP	1369	
Composite Load Factor		0.49

Source: LAHD Al Larson Boat Shop EIR

Source: LAHD Al Larson Boat Shop EIR

Legend:

Information provided by LAHD

Information assumed by iLanco and Envicraft

Table B1.6. Construction Vehicles

Used for combustion exhaust and road dust calculations

Task ID	Task	Work Days	Vehicle Type	Description	Total Loads	Peak Day Loads
3	Installation of VDU - Shell					
4	Construct Piping Trenches	40	support trucks	(1) Pickups (3hrs./Day Ea.)	12	12
4			haul trucks	(1) Dump Trailer Haulers (6hrs	1	1
4			concrete trucks	(2) Concrete Delivery Truck (4	2	2
5	Install DSU and VDU Equipment	16	support trucks	(1) Pickups (3hrs./Day Ea.)	12	12
6	Install DSU and VDU Piping, Controls and Elec	50	support trucks	(3) Pickups (3hrs./Day EA.)	36	36
6			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	6	2
7	Testing and Commissioning	10	support trucks	(2) Pickup (3hrs./Day)	24	24
8	Pre Demo Activities for B168 Demolition- Shell					
9	Decommission Berth 168					
10	Revise Fire Water Berth 168	30	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
10			haul trucks	(2) Dump Trailer Hauler (3hrs.,	6	2
10			concrete trucks	(2) Concrete Trucks (8hrs./Da	4	4
10			delivery trucks	Flatbed Semi Hauler - Equipme	6	4
11	Electrical Supply to Berth 169	21	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
11			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	2	2
12	Revise Elec & Utilities on Berth 169	21	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
13	Demo Topsides Berth 168	11	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
13			haul trucks	(2) Dump Trailer Hauler (4hrs.,	8	2
14	Site Preparation Activities					
15	Demo Product Piping, Elec, and Utilities	80	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
15			haul trucks	(2) Dump Trailer Hauler (8hrs.,	24	4
16	Install Temp Jet Line	25	support trucks	(3) Pickups (3hrs./Day)	36	36
16			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	2	2
17	Demo Supports and Paving	10	support trucks	(2) Pickup (3hrs./Day)	24	24
17			haul trucks	(2) Dump Trailer Hauler (4hrs.,	4	2
18	Berth 168 Demolition and Improvements - Port					
19	Demolition of Berth 168	78	haul trucks	Dump Trucks to remove concr	1872	25
20	Construct Berth 168	260				
21	Pile Driving	87	delivery trucks	Haul truck for pile delivery	65	1
22	Deck Construction and Dolphin Construction	140	delivery trucks	Delivery trucks	220	2
23	Trestle and Catwalk Construction	31	concrete trucks	haul trucks for concrete delive	1	1
23			haul trucks	haul trucks for concrete pump	1	1
23			delivery trucks	delivery trucks	16	1
24	Dredging @ Berth 168	10				
25	Shell MOTEMS Construction Activities	220				
26	Shoreside Improvements					
27	Pipe Supports					
28	Pile Installation	60	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
28			delivery trucks	(4) Flatbed Semi Hauler (3hrs.,	64	4
29	Pile Cap and Manifold Support Structures	30	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
29			delivery trucks	(4) Flatbed Semi Hauler (8hrs.,	8	4
30	Repair HDPE Below Grade Wall	10	support trucks	(2) Pickup (3hrs./Day)	24	24
30			haul trucks	(2) Dump Trailer Hauler (4hrs.,	6	2
31	Pave and Prep Area	20	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
31			haul trucks	(4) Dump Trailer Hauler (8hrs.,	80	8
31			concrete trucks	(2) Concrete Delivery Truck (6l	80	8
32	Product Piping					
33	Product Piping Above Grade	60	support trucks	(6) Pickups (3hrs./Day EA.)	72	72
33			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	40	2
34	Elec., Utilities, Fire Water, Controls	30	support trucks	(4) Pickup (3hrs./Day)	48	48
34			haul trucks	(2) Flatbed Semi Hauler (3hrs.,	6	2
35	Access Platforms	15	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
35			delivery trucks	(4) Flatbed Semi Hauler (3hrs.,	8	4
36	Topside Improvements					
37	Install Gangway, Loading Arms, DSU and VDU , &	30	support trucks	(4) Pickup (3hrs./Day)	48	48
37			delivery trucks	(4) Flatbed Semi Hauler (3hrs.,	16	4
38	Product Piping	10	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
38			haul trucks	(2) Flatbed Semi Hauler (3hrs.,	10	2
39	Elec., Utilities, Fire Water, Controls	50	support trucks	(4) Pickup (3hrs./Day)	48	48
39			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	2	2
40	Testing and Commissioning	40	support trucks	(2) Pickup (3hrs./Day)	24	24
41	Shell Decommissioning Berth 169					
42	Remove Temp Jet Line	10	support trucks	(2) Pickups (3hrs./Day)	48	48
42			haul trucks	(2) Dump Trailer Haulers (3hrs	2	2
43	Decommission Berth 169	10				
44	Demo Topsides Berth 169	10	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
44			haul trucks	(2) Dump Trailer Hauler (4hrs.,	8	2
45	POLA Demolition Activities Berth 169					
46	Demolition of Berth 169	65	haul trucks	Dump trucks to remove concr	1560	25
47	Pile Driving	19	delivery trucks	Haul truck for pile delivery	10	1
48	Catwalk Construction	66	concrete trucks	haul trucks for concrete delive	1	1
48			haul trucks	haul trucks for concrete pump	1	1
48			delivery trucks	delivery trucks	25	1
49	Revise Fire Water Berth 169	10	support trucks	(4) Pickups (3hrs./Day EA.)	48	48

Table B1.6.

Used for debris handling dust calculations

Task ID	Onsite Idling (hr)	Onsite			Transit Location	Worker Vehicles	Dust Source	Peak Day Volume Handled (ton/day)	Total Volume Handled (ton/yr)
		Onsite Transit (mi/trip)	SCAB Transit (mi/1-way trip)	Offsite CA Transit (mi/1-way trip)					
3									
4	0.17	0.5				5			
4	0.17	0.5	10	10			4soil handlir	40	
4	0.17	0.5	35	35					
5	0.17	0.5				7			
6	0.17	0.5				8			
6	0.17	0.5	35	35					
7	0.17	0.5				8			
8									
9									
10	0.17	0.5				12			
10	0.17	0.5	35	35					
10	0.17	0.5	35	35					
10	0.17	0.5	35	35					
11	0.17	0.5				12			
11	0.17	0.5	35	35					
12	0.17	0.5				12			
13	0.17	0.5				8			
13	0.17	0.5	35	35					
14									
15	0.17	0.5				12			
15	0.17	0.5	35	35					
16	0.17	0.5				7			
16	0.17	0.5	35	35					
17	0.17	0.5				8			
17	0.17	0.5	35	35					
18									
19	0.17	0.5	20	20		12			
20									
21	0.17	0.5	60	800		8			
22	0.17	0.5	20	20		12			
23	0.17	0.5	40	40		12			
23	0.17	0.5							
23	0.17	0.5	20	20					
24						8			
25									
26									
27									
28	0.17	0.5				18			
28	0.17	0.5	80	80					
29	0.17	0.5				18			
29	0.17	0.5	35	35					
30	0.17	0.5				8			
30	0.17	0.5	35	35			30soil handl	25	
31	0.17	0.5				8			
31	0.17	0.5	35	35					
31	0.17	0.5	35	35					
32									
33	0.17	0.5				24			
33	0.17	0.5	80	80					
34	0.17	0.5				12			
34	0.17	0.5	80	80					
35	0.17	0.5				18			
35	0.17	0.5	80	80					
36									
37	0.17	0.5				12			
37	0.17	0.5	80	80					
38	0.17	0.5				16			
38	0.17	0.5	80	80					
39	0.17	0.5				12			
39			80	80					
40	0.17	0.5				8			
41									
42	0.17	0.5				7			
42	0.17	0.5	80	80					
43						5			
44	0.17	0.5				8			
44	0.17	0.5	80	80					
45									
46	0.17	0.5	20	20		12			
47	0.17	0.5	60	800		8			
48	0.17	0.5	40	40		12			
48	0.17	0.5							
48	0.17	0.5	20	20					
49	0.17	0.5				12			

Table B1.6. Construction Vehicles

Used for combustion exhaust and road dust calculations

Task ID	Task	Work Days	Vehicle Type	Description	Total Loads	Peak Day Loads
49			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	2	2
50	Dredging @ Berth 169	10				
51	Platform 2 Construction at Berth 169					
52	Pile Driving	87	delivery trucks	Haul truck for pile delivery	65	1
53	Platform Construction	140	delivery trucks	Delivery trucks	220	2
54	Trestle and Catwalk Construction	31	concrete trucks	haul trucks for concrete delive	1	1
54			haul trucks	haul trucks for concrete pump	1	1
54			delivery trucks	delivery trucks	16	1
55	Topside Equipment Replacement					
56	Install Gangway, Loading Arms, DSU and VDU , &	30	support trucks	(4) Pickup (3hrs./Day)	48	48
56			delivery trucks	(4) Flatbed Semi Hauler (3hrs.,	16	4
57	Product Piping	10	support trucks	(4) Pickups (3hrs./Day EA.)	48	48
57			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	10	2
58	Elec., Utilities, Fire Water, Controls	50	support trucks	(4) Pickup (3hrs./Day)	48	48
58			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	2	2
59	Testing and Commissioning	40	support trucks	(2) Pickup (3hrs./Day)	24	24
60	Clean-Up Dredging	10				
61	Source Control Program					
62	Source Control Program	225	support trucks	(2) Pickups (3hrs./Day)	48	48
62			haul trucks	(2) Dump Trailer Haulers (3hrs	120	8
62			delivery trucks	(2) Flatbed Semi Hauler (3hrs.,	160	16
62						

Table B1.6. Construction Vehicles

Used for combustion exhaust and road dust calculations

Task ID	Task	Work Days	Vehicle Type	Description	Total Loads	Peak Day Loads
Notes:						
	Onsite truck idling is 5 minutes per trip x 2 one-way trips = 10 minu		0.17			
	Onsite vehicle speed (mi/hr)		5			
	Support vehicles assumed to travel onsite (mi/load)		0.5			
Construction vehicle and worker one-way vehicle transit miles (not provided by LAHD) were obtained from CalEEMod, Appendix A, Chapter 4.5 and associated Appendix D, Table 4.2 for Los Angeles - South Coast as well as from APL EIR/EIS and Google Maps.						
	VMT for haul trucks:		20 miles one-way			
	VMT for pile delivery: piles will come from north of San Francisco		60 miles one-way to AQMD boundary			
	VMT for pile delivery: piles will come from north of San Francisco		800 miles one-way to CA border			
	VMT for onsite travel assumed:		0.5 miles/one-way trip			
	VMT for workers, Home-Work VMT (CalEEMod default):		12.7 miles one-way			
Construction worker counts were provided by LAHD:						
	Demolition		12 workers			
	Pile Driving		8 workers			
	Deck Construction/Mooring		12 workers			
	Dredging		8 workers			

Legend:

Information provided by LAHD
Information assumed by iLanco and Envicraft

Table B1.7. Dredging Activity

	Onsite Shell (quantity)	Onsite CDF (quantity)	Offsite (quantity)
Tugboat propulsion	1	1	1
Tugboat auxiliary	1	1	
Derrick Barge	1		
Flat Barge		1	
Worker Vehicles			8

Notes:

A tugboat is used to position and maneuver the derrick barge. A tugboat is used to push flat barge from Shell to CDF.

The derrick barge is assumed to operate on-board equipment during dredging only.

The flat barge is assumed to operate on-board equipment during transfer of materials into CDF only.

Table B1.8. Thermal Oxidizer Combustion Emissions

Tank Capacity				Rating		Propane Emission Factors [4],[5]							
Tank Capacity [1]	Tank Capacity	Max Process Flow Rate	Time to Degas Tank	Propane [2]	Natural Gas [3]	NOx	PM	SOx	CO	VOC	CO2	CH4	N2O
bbl	scf	scfm	hr	gal/hr	MMBtu/hr	lb/1000 gal	lb/1000 gal	lb/1000 gal	lb/1000 gal	lb/1000 gal	kg CO2/gal	kg/MMBtu	kg/MMBtu
98,993	555,843	4,000	2.3	460	42.2	12.8	0.28	0.054	3.2	0.26	5.72	0.003	0.0006
						Natural Gas Emission Factors [4],[5]							
						NOx	PM	SOx	CO	VOC	CO2	CH4	N2O
						lb/MMcf	lb/MMcf	lb/MMcf	lb/MMcf	lb/MMcf	kg CO2/MMBtu	kg/MMBtu	kg/MMBtu
						130	7.5	0.6	35	7	53.06	0.001	0.0001
						Propane Emissions							
						NOx	PM	SOx	CO	VOC	CO2	CH4	N2O
						lb/day	lb/day	lb/day	lb/day	lb/day	tonnes	tonnes	tonnes
						13.64	0.30	0.06	3.41	0.28	91.43	0.05	0.01
						Natural Gas Emissions							
						NOx	PM	SOx	CO	VOC	CO2	CH4	N2O
						lb/day	lb/day	lb/day	lb/day	lb/day	tonnes	tonnes	tonnes
						12.46	0.72	0.06	3.35	0.67	77.79	0.00	0.00

Notes:

[1] Tank M27 was chosen for the peak day as it is the largest tank. Pipeline emissions are assumed to be equal or less than the tank emissions. 2 tanks and 1 pipeline assumed per year.

[2], [3] Thermal Oxidizer design specifications for EMECS 42 MMBtu/hr.

[4] Criteria pollutant emission factors are from SCAQMD AER Emission Factors.

[5] GHG pollutant emission factors are from The Climate Registry 2015.

Table B1.9. Thermal Oxidizer Permit Limit

< 40	NOx lb/day permit limit
130	lb NOx/MMcf natural gas
12.8	lb NOx/1000 gal propane
< 30	VOC lb/day permit limit
4000	scfm inlet gas flow permit limit

Source:

AP42, Chapter 1, Table 1.5-1 (0.10 S). S is the sulfur content of propane (0.54 g/1000 ft³) (Reference: EPA. Bernd H. Haneke. A National Methodology and Emission Inventory for residential Fuel Combustion).

Table B1.10. Tank Degassing Emissions

Storage Tank M27 [1]	lb VOC/tank	lb VOC/hr	lb VOC/day	lb VOC total
Displacement of vapors in tank [2]	4.82			
Displacement of vapors under domed roof [3]	5,889			
Thermal Oxidizer Control Efficiency	99.9%			
VOC Emissions	5.89	2.54	5.89	88.41

Source: EPA TANKS 4.09 program

Notes:

[1] Tank M27 was chosen for the peak day as it is the largest tank. Data necessary to run TANKS was obtained from the Facility Title V permit.

[2] Displacement of vapors from the tank during degassing was estimated by assuming 1 turnover and calculating working losses.

[3] Displacement of vapors from the under the domed roof, during degassing was estimated by assuming a fixed roof tank with a 6 foot height (approximate height of the roof legs), 1 turnover and calculating working losses.

Tanks degassed per year: 2
 Assume that degassed pipeline is equal to 1 degassed tank. Pipelines degassed per year: 1
 Total tanks degassed: 10
 Total pipelines degassed: 5

Table B1.11. Shell Marine Terminal - Tank Data

AER Device ID	Permit Device ID	A/N	Process ID	Equipment	Dimensions (feet)			Capacity bbl	Type	Product	Throughput Mgal	EF ROG lb/Mgal	Emissions lb/yr
					Length	Height	Diameter						
ES1	F16904	346002	P1	Storage Tank AG-	13		6.291666667	71.42857143	Horizontal	Shell Turboflo S	0	6.81E+12	0.68
ES2	F16807	346005	P1	Storage Tank M1		29.67	140.00	78353.00	Vertical Fixed R	Shell Jet A	5.76	9.874	56.89
ES3	F16805	346006	P1	Storage Tank M2		29.67	140.00	78353.00	Vertical Fixed R	Shell Jet A	405.15	2.1365	865.61
ES8	G24438	415862	P1	Storage Tank M25		48	70	29037	Domed External	Shell Transmix	187.6	3.1329	587.71
ES11	G24430	427856	P1	Storage Tank M17		29.42	36.00	4455.00	Domed External	Shell Contact W	1.62	4.9828	8.08
ES12	G24429	427857	P1	Storage Tank M5		28.42	50.00	7303.00	Domed External	Shell Transmix	55.38	8.3019	459.73
ES13	G24431	456579	P1	Storage Tank M26		48	122	98950	Domed External	Shell Denatured	5321.65	0.0346	183.93
ES14	G24433	456580	P1	Storage Tank M27		48	122	98993	Domed External	Shell Gasoline	1273.09	0.6941	883.67
ES15	G7606	479011	P1	Storage Tank M28		48	38.41666667	9593	Vertical Fixed R	Distillate fuel oi	0.52	141.4188	73.68
ES17	F66165	3361 / 550575	P1	Storage Tank M10A		42	117	75178	Domed External	Shell Denatured	3651.17	0.0662	241.54
ES18	F66166	3362 / 550576	P1	Storage Tank M24		40	120	69130	Domed External	Shell Denatured	2085.5	0.1095	228.41
	F16849	346009		Storage Tank M6		28	50	10000	Domed External Floating Roof				
Total												3589.93	

Source: AER data supplied by Erin Sheehy (11/5/2015).

Table B1.12. Construction Marine Engine Characteristics and Emission Factors

HC Characteristics								
Year	HC Classification	Engine Type	Engine				Retrofit Model	
			Count per HC	Average Model Year	HC Average Power (hp)	HC Average Power (kW)	Load Factor	Year
2016+	tugboat	propulsion	2	2008	683	509	0.31	>2020
	tugboat	auxiliary	1	2009	48	36	0.43	>2020
	workboat	propulsion	2	2010	509	380	0.38	>2020
	workboat	auxiliary	1	2002	59	44	0.32	>2020

Source:
 HC model year, hp, and load factor: 2013 POLA Emissions Inventory, Tables 4.1 and 4.2.

HC Classification Engine Type		Unmitigated Emission Factors										
		Engine Tier	PM10 (g/kW-hr)	PM2.5 (g/kW-hr)	DPM (g/kW-hr)	NOX (g/kW-hr)	SOX (g/kW-hr)	CO (g/kW-hr)	VOC (g/kW-hr)	CO2 (g/kW-hr)	CH4 (g/kW-hr)	N2O (g/kW-hr)
tugboat	propulsion	Tier 2	0.45	0.40	0.45	8.95	0.01	5.00	0.47	652.00	0.01	0.03
tugboat	auxiliary	Tier 2	0.30	0.27	0.30	6.91	0.01	5.00	0.36	652.00	0.01	0.03
workboat	propulsion	Tier 2	0.45	0.40	0.45	8.95	0.01	5.00	0.47	652.00	0.01	0.03
workboat	auxiliary	Tier 2	0.30	0.27	0.30	6.91	0.01	5.00	0.36	652.00	0.01	0.03

Source: EPA engine standards

HC Classification Engine Type		Mitigated Emission Factors										
		Engine Tier	PM10 (g/kW-hr)	PM2.5 (g/kW-hr)	DPM (g/kW-hr)	NOX (g/kW-hr)	SOX (g/kW-hr)	CO (g/kW-hr)	VOC (g/kW-hr)	CO2 (g/kW-hr)	CH4 (g/kW-hr)	N2O (g/kW-hr)
tugboat	propulsion	Tier 3	0.23	0.21	0.23	7.94	0.01	5.00	0.44	652.00	0.01	0.03
tugboat	auxiliary	Tier 3	0.33	0.30	0.33	6.24	0.01	5.87	0.35	652.00	0.01	0.03
workboat	propulsion	Tier 3	0.23	0.21	0.23	7.94	0.01	5.00	0.42	652.00	0.01	0.03
workboat	auxiliary	Tier 3	0.33	0.30	0.33	6.24	0.01	5.87	0.33	652.00	0.01	0.03

Source: EPA engine standards

**Construction Offroad Engine
Characteristics and Emission**

Table B1.13. Factors

Year	Offroad2011 Equipment Category	Offroad2007 Equipment Category	Engine (Hp)	Load Factor	Emission Factor Units
2018	Aerial Lifts	Aerial Lifts	63		0.31 g/hp-hr
2018	Bore/Drill Rigs	Bore/Drill Rigs	206		0.54 g/hp-hr
2018	Cranes	Cranes	226		0.29 g/hp-hr
2018	Excavators	Excavators	163		0.38 g/hp-hr
2018	Forklifts	Forklifts	89		0.20 g/hp-hr
2018	Generator Sets	Generator Sets	84		0.74 g/hp-hr
2018	Graders	Graders	175		0.41 g/hp-hr
2018	Off-Highway Trucks	Off-Highway Trucks	400		0.38 g/hp-hr
2018	Other Construction Equipment	Other Construction Equipment	172		0.42 g/hp-hr
2018	Other General Industrial Equipment	Other General Industrial Equipment	88		0.34 g/hp-hr
2018	Pavers	Pavers	126		0.42 g/hp-hr
2018	Rollers	Rollers	81		0.38 g/hp-hr
2018	Rubber Tired Dozers	Rubber Tired Dozers	255		0.40 g/hp-hr
2018	Skid Steer Loaders	Skid Steer Loaders	65		0.37 g/hp-hr
2018	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	98		0.37 g/hp-hr

**Construction Offroad Engine
Characteristics and Emission**

Table B1.13. Factors

Year	Offroad2011 Equipment Category	Emission Factors, Unmitigated									
		PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
2018	Aerial Lifts	0.0203	0.0187	0.0203	1.7414	0.0050	5.1443	0.0731	529.0999	0.0298	0.0133
2018	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0047	3.7000	0.4000	496.4919	0.0280	0.0124
2018	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.9353	0.0299	0.0133
2018	Excavators	0.0096	0.0089	0.0096	0.9620	0.0050	5.0206	0.0827	532.0955	0.0300	0.0133
2018	Forklifts	0.0213	0.0196	0.0213	1.6918	0.0050	5.7613	0.0932	532.2574	0.0300	0.0133
2018	Generator Sets	0.0104	0.0096	0.0104	0.9416	0.0028	3.0133	0.0476	301.1156	0.0170	0.0076
2018	Graders	0.0093	0.0086	0.0093	0.3892	0.0050	4.9760	0.0657	531.7305	0.0300	0.0133
2018	Off-Highway Trucks	0.0104	0.0095	0.0104	0.4319	0.0050	5.1156	0.0975	532.8472	0.0301	0.0134
2018	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	525.6636	0.0297	0.0132
2018	Other General Industri	0.0211	0.0194	0.0211	1.6849	0.0050	5.8567	0.0958	532.2543	0.0300	0.0133
2018	Pavers	0.0091	0.0084	0.0091	0.9562	0.0049	4.9904	0.0688	526.0997	0.0297	0.0132
2018	Rollers	0.0226	0.0208	0.0226	1.7237	0.0049	5.5596	0.0782	526.7057	0.0297	0.0132
2018	Rubber Tired Dozers	0.0101	0.0093	0.0101	0.6435	0.0050	3.2813	0.0960	535.4330	0.0302	0.0134
2018	Skid Steer Loaders	0.0186	0.0171	0.0186	1.6723	0.0050	5.2944	0.0769	530.1916	0.0299	0.0133
2018	Tractors/Loaders/Back	0.0203	0.0186	0.0203	1.6627	0.0050	5.5949	0.0945	530.8881	0.0300	0.0133

**Construction Offroad Engine
Characteristics and Emission**

Table B1.13. Factors

Year	Offroad2011 Equipment Category	Emission Factors, Mitigated									
		PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
2018	Aerial Lifts	0.0200	0.0187	0.0200	1.7414	0.0050	3.7000	0.0731	529.0999	0.0298	0.0133
2018	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0047	3.7000	0.4000	496.4919	0.0280	0.0124
2018	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.9353	0.0299	0.0133
2018	Excavators	0.0096	0.0089	0.0096	0.3000	0.0050	3.7000	0.0827	532.0955	0.0300	0.0133
2018	Forklifts	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.0932	532.2574	0.0300	0.0133
2018	Generator Sets	0.0104	0.0096	0.0104	0.9416	0.0028	3.0133	0.0476	301.1156	0.0170	0.0076
2018	Graders	0.0093	0.0086	0.0093	0.3000	0.0050	3.7000	0.0657	531.7305	0.0300	0.0133
2018	Off-Highway Trucks	0.0104	0.0095	0.0104	0.3000	0.0050	2.2000	0.0975	532.8472	0.0301	0.0134
2018	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	525.6636	0.0297	0.0132
2018	Other General Industri	0.0211	0.0194	0.0211	1.6849	0.0050	5.8567	0.0958	532.2543	0.0300	0.0133
2018	Pavers	0.0091	0.0084	0.0091	0.3000	0.0049	3.7000	0.0688	526.0997	0.0297	0.0132
2018	Rollers	0.0200	0.0200	0.0200	1.7237	0.0049	3.7000	0.0782	526.7057	0.0297	0.0132
2018	Rubber Tired Dozers	0.0101	0.0093	0.0101	0.3000	0.0050	2.2000	0.0960	535.4330	0.0302	0.0134
2018	Skid Steer Loaders	0.0186	0.0171	0.0186	1.6723	0.0050	3.7000	0.0769	530.1916	0.0299	0.0133
2018	Tractors/Loaders/Back	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.0945	530.8881	0.0300	0.0133

**Construction Offroad Engine
Characteristics and Emission**

Table B1.13. Factors

Year	Offroad2011 Equipment Category	Offroad2007 Equipment Category	Engine (Hp)	Load Factor	Emission Factor Units
2019	Aerial Lifts	Aerial Lifts	63		0.31 g/hp-hr
2019	Bore/Drill Rigs	Bore/Drill Rigs	206		0.54 g/hp-hr
2019	Cranes	Cranes	226		0.29 g/hp-hr
2019	Excavators	Excavators	163		0.38 g/hp-hr
2019	Forklifts	Forklifts	89		0.20 g/hp-hr
2019	Generator Sets	Generator Sets	84		0.74 g/hp-hr
2019	Graders	Graders	175		0.41 g/hp-hr
2019	Off-Highway Trucks	Off-Highway Trucks	400		0.38 g/hp-hr
2019	Other Construction Equipment	Other Construction Equipment	172		0.42 g/hp-hr
2019	Other General Industrial Equipment	Other General Industrial Equipment	88		0.34 g/hp-hr
2019	Pavers	Pavers	126		0.42 g/hp-hr
2019	Rollers	Rollers	81		0.38 g/hp-hr
2019	Rubber Tired Dozers	Rubber Tired Dozers	255		0.40 g/hp-hr
2019	Skid Steer Loaders	Skid Steer Loaders	65		0.37 g/hp-hr
2019	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	98		0.37 g/hp-hr
2020	Aerial Lifts	Aerial Lifts	63		0.31 g/hp-hr
2020	Bore/Drill Rigs	Bore/Drill Rigs	206		0.54 g/hp-hr
2020	Cranes	Cranes	226		0.29 g/hp-hr
2020	Excavators	Excavators	163		0.38 g/hp-hr
2020	Forklifts	Forklifts	89		0.20 g/hp-hr
2020	Generator Sets	Generator Sets	84		0.74 g/hp-hr
2020	Graders	Graders	175		0.41 g/hp-hr
2020	Off-Highway Trucks	Off-Highway Trucks	400		0.38 g/hp-hr
2020	Other Construction Equipment	Other Construction Equipment	172		0.42 g/hp-hr
2020	Other General Industrial Equipment	Other General Industrial Equipment	88		0.34 g/hp-hr
2020	Pavers	Pavers	126		0.42 g/hp-hr
2020	Rollers	Rollers	81		0.38 g/hp-hr
2020	Rubber Tired Dozers	Rubber Tired Dozers	255		0.40 g/hp-hr
2020	Skid Steer Loaders	Skid Steer Loaders	65		0.37 g/hp-hr
2020	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	98		0.37 g/hp-hr
2021	Aerial Lifts	Aerial Lifts	63		0.31 g/hp-hr
2021	Bore/Drill Rigs	Bore/Drill Rigs	206		0.54 g/hp-hr
2021	Cranes	Cranes	226		0.29 g/hp-hr
2021	Excavators	Excavators	163		0.38 g/hp-hr
2021	Forklifts	Forklifts	89		0.20 g/hp-hr

**Construction Offroad Engine
Characteristics and Emission**

Table B1.13. Factors

Year	Offroad2011 Equipment Category	Emission Factors, Unmitigated									
		PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
2019	Aerial Lifts	0.0195	0.0179	0.0195	1.7159	0.0050	5.1108	0.0752	529.1017	0.0298	0.0133
2019	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0047	3.7000	0.4000	496.4659	0.0280	0.0124
2019	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.5897	0.0299	0.0133
2019	Excavators	0.0097	0.0090	0.0097	0.8359	0.0050	5.0192	0.0823	532.6543	0.0300	0.0134
2019	Forklifts	0.0202	0.0185	0.0202	1.6475	0.0050	5.7378	0.0969	532.2569	0.0300	0.0133
2019	Generator Sets	0.0095	0.0088	0.0095	0.9039	0.0028	3.0006	0.0479	300.6719	0.0170	0.0075
2019	Graders	0.0093	0.0086	0.0093	0.3418	0.0050	4.9718	0.0644	529.8305	0.0299	0.0133
2019	Off-Highway Trucks	0.0106	0.0097	0.0106	0.4093	0.0050	5.1138	0.1026	533.2885	0.0301	0.0134
2019	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	525.2614	0.0296	0.0132
2019	Other General Industri	0.0198	0.0182	0.0198	1.6341	0.0050	5.8220	0.0991	532.2543	0.0300	0.0133
2019	Pavers	0.0091	0.0084	0.0091	0.7886	0.0049	4.9788	0.0662	526.6142	0.0297	0.0132
2019	Rollers	0.0207	0.0191	0.0207	1.6642	0.0049	5.5269	0.0792	526.8713	0.0297	0.0132
2019	Rubber Tired Dozers	0.0102	0.0094	0.0102	0.6319	0.0050	3.1012	0.1006	534.8351	0.0302	0.0134
2019	Skid Steer Loaders	0.0173	0.0159	0.0173	1.6270	0.0050	5.2859	0.0783	530.5025	0.0299	0.0133
2019	Tractors/Loaders/Back	0.0182	0.0168	0.0182	1.5982	0.0050	5.5748	0.0954	530.8337	0.0299	0.0133
2020	Aerial Lifts	0.0162	0.0149	0.0162	1.6366	0.0050	5.0863	0.0750	529.1050	0.0298	0.0133
2020	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0047	3.7000	0.4000	497.8147	0.0281	0.0125
2020	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.5834	0.0299	0.0133
2020	Excavators	0.0099	0.0091	0.0099	0.7471	0.0050	5.0179	0.0831	532.8458	0.0301	0.0134
2020	Forklifts	0.0193	0.0177	0.0193	1.6150	0.0050	5.7174	0.1007	532.2578	0.0300	0.0133
2020	Generator Sets	0.0091	0.0084	0.0091	0.8845	0.0028	2.9916	0.0495	300.1225	0.0169	0.0075
2020	Graders	0.0095	0.0087	0.0095	0.3302	0.0050	4.9681	0.0690	529.9907	0.0299	0.0133
2020	Off-Highway Trucks	0.0108	0.0099	0.0108	0.3782	0.0050	5.1122	0.1062	533.3723	0.0301	0.0134
2020	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	525.4513	0.0296	0.0132
2020	Other General Industri	0.0192	0.0176	0.0192	1.6078	0.0050	5.7976	0.1039	532.2543	0.0300	0.0133
2020	Pavers	0.0093	0.0085	0.0093	0.7448	0.0049	4.9687	0.0682	527.4831	0.0298	0.0132
2020	Rollers	0.0194	0.0178	0.0194	1.6262	0.0049	5.4971	0.0811	526.6710	0.0297	0.0132
2020	Rubber Tired Dozers	0.0104	0.0096	0.0104	0.5691	0.0050	2.9429	0.1045	532.5927	0.0300	0.0134
2020	Skid Steer Loaders	0.0159	0.0146	0.0159	1.5842	0.0050	5.2795	0.0795	530.2128	0.0299	0.0133
2020	Tractors/Loaders/Back	0.0167	0.0154	0.0167	1.5543	0.0050	5.5578	0.0973	531.3258	0.0300	0.0133
2021	Aerial Lifts	0.0125	0.0115	0.0125	1.5517	0.0050	5.0599	0.0739	529.1071	0.0298	0.0133
2021	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0047	3.7000	0.4000	496.5206	0.0280	0.0124
2021	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.4956	0.0299	0.0133
2021	Excavators	0.0100	0.0092	0.0100	0.6795	0.0050	5.0169	0.0842	532.7473	0.0301	0.0134
2021	Forklifts	0.0186	0.0171	0.0186	1.5908	0.0050	5.6844	0.1047	532.2568	0.0300	0.0133

**Construction Offroad Engine
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Table B1.13. Factors

Year	Offroad2011 Equipment Category	Emission Factors, Mitigated									
		PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
2019	Aerial Lifts	0.0195	0.0179	0.0195	1.7159	0.0050	3.7000	0.0752	529.1017	0.0298	0.0133
2019	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0047	3.7000	0.4000	496.4659	0.0280	0.0124
2019	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.5897	0.0299	0.0133
2019	Excavators	0.0097	0.0090	0.0097	0.3000	0.0050	3.7000	0.0823	532.6543	0.0300	0.0134
2019	Forklifts	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.0969	532.2569	0.0300	0.0133
2019	Generator Sets	0.0095	0.0088	0.0095	0.9039	0.0028	3.0006	0.0479	300.6719	0.0170	0.0075
2019	Graders	0.0093	0.0086	0.0093	0.3000	0.0050	3.7000	0.0644	529.8305	0.0299	0.0133
2019	Off-Highway Trucks	0.0106	0.0097	0.0106	0.3000	0.0050	2.2000	0.1026	533.2885	0.0301	0.0134
2019	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	525.2614	0.0296	0.0132
2019	Other General Industri	0.0198	0.0182	0.0198	1.6341	0.0050	5.8220	0.0991	532.2543	0.0300	0.0133
2019	Pavers	0.0091	0.0084	0.0091	0.3000	0.0049	3.7000	0.0662	526.6142	0.0297	0.0132
2019	Rollers	0.0200	0.0191	0.0200	1.6642	0.0049	3.7000	0.0792	526.8713	0.0297	0.0132
2019	Rubber Tired Dozers	0.0102	0.0094	0.0102	0.3000	0.0050	2.2000	0.1006	534.8351	0.0302	0.0134
2019	Skid Steer Loaders	0.0173	0.0159	0.0173	1.6270	0.0050	3.7000	0.0783	530.5025	0.0299	0.0133
2019	Tractors/Loaders/Back	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.0954	530.8337	0.0299	0.0133
2020	Aerial Lifts	0.0162	0.0149	0.0162	1.6366	0.0050	3.7000	0.0750	529.1050	0.0298	0.0133
2020	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0047	3.7000	0.4000	497.8147	0.0281	0.0125
2020	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.5834	0.0299	0.0133
2020	Excavators	0.0099	0.0091	0.0099	0.3000	0.0050	3.7000	0.0831	532.8458	0.0301	0.0134
2020	Forklifts	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.1007	532.2578	0.0300	0.0133
2020	Generator Sets	0.0091	0.0084	0.0091	0.8845	0.0028	2.9916	0.0495	300.1225	0.0169	0.0075
2020	Graders	0.0095	0.0087	0.0095	0.3000	0.0050	3.7000	0.0690	529.9907	0.0299	0.0133
2020	Off-Highway Trucks	0.0108	0.0099	0.0108	0.3000	0.0050	2.2000	0.1062	533.3723	0.0301	0.0134
2020	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0000	3.7000	0.4000	525.4513	0.0296	0.0132
2020	Other General Industri	0.0192	0.0176	0.0192	1.6078	0.0050	5.7976	0.1039	532.2543	0.0300	0.0133
2020	Pavers	0.0093	0.0085	0.0093	0.3000	0.0049	3.7000	0.0682	527.4831	0.0298	0.0132
2020	Rollers	0.0194	0.0178	0.0194	1.6262	0.0049	3.7000	0.0811	526.6710	0.0297	0.0132
2020	Rubber Tired Dozers	0.0104	0.0096	0.0104	0.3000	0.0050	2.2000	0.1045	532.5927	0.0300	0.0134
2020	Skid Steer Loaders	0.0159	0.0146	0.0159	1.5842	0.0050	3.7000	0.0795	530.2128	0.0299	0.0133
2020	Tractors/Loaders/Back	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.0973	531.3258	0.0300	0.0133
2021	Aerial Lifts	0.0125	0.0115	0.0125	1.5517	0.0050	3.7000	0.0739	529.1071	0.0298	0.0133
2021	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0047	3.7000	0.4000	496.5206	0.0280	0.0124
2021	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.4956	0.0299	0.0133
2021	Excavators	0.0100	0.0092	0.0100	0.3000	0.0050	3.7000	0.0842	532.7473	0.0301	0.0134
2021	Forklifts	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.1047	532.2568	0.0300	0.0133

**Construction Offroad Engine
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Table B1.13. Factors

Year	Offroad2011 Equipment Category	Offroad2007 Equipment Category	Engine (Hp)	Load Factor	Emission Factor Units
2021	Generator Sets	Generator Sets	84	0.74	g/hp-hr
2021	Graders	Graders	175	0.41	g/hp-hr
2021	Off-Highway Trucks	Off-Highway Trucks	400	0.38	g/hp-hr
2021	Other Construction Equipment	Other Construction Equipment	172	0.42	g/hp-hr
2021	Other General Industrial Equipment	Other General Industrial Equipment	88	0.34	g/hp-hr
2021	Pavers	Pavers	126	0.42	g/hp-hr
2021	Rollers	Rollers	81	0.38	g/hp-hr
2021	Rubber Tired Dozers	Rubber Tired Dozers	255	0.40	g/hp-hr
2021	Skid Steer Loaders	Skid Steer Loaders	65	0.37	g/hp-hr
2021	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	98	0.37	g/hp-hr
2022	Aerial Lifts	Aerial Lifts	63	0.31	g/hp-hr
2022	Bore/Drill Rigs	Bore/Drill Rigs	206	0.54	g/hp-hr
2022	Cranes	Cranes	226	0.29	g/hp-hr
2022	Excavators	Excavators	163	0.38	g/hp-hr
2022	Forklifts	Forklifts	89	0.20	g/hp-hr
2022	Generator Sets	Generator Sets	84	0.74	g/hp-hr
2022	Graders	Graders	175	0.41	g/hp-hr
2022	Off-Highway Trucks	Off-Highway Trucks	400	0.38	g/hp-hr
2022	Other Construction Equipment	Other Construction Equipment	172	0.42	g/hp-hr
2022	Other General Industrial Equipment	Other General Industrial Equipment	88	0.34	g/hp-hr
2022	Pavers	Pavers	126	0.42	g/hp-hr
2022	Rollers	Rollers	81	0.38	g/hp-hr
2022	Rubber Tired Dozers	Rubber Tired Dozers	255	0.40	g/hp-hr
2022	Skid Steer Loaders	Skid Steer Loaders	65	0.37	g/hp-hr
2022	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	98	0.37	g/hp-hr
2023	Aerial Lifts	Aerial Lifts	63	0.31	g/hp-hr
2023	Bore/Drill Rigs	Bore/Drill Rigs	206	0.54	g/hp-hr
2023	Cranes	Cranes	226	0.29	g/hp-hr
2023	Excavators	Excavators	163	0.38	g/hp-hr
2023	Forklifts	Forklifts	89	0.20	g/hp-hr
2023	Generator Sets	Generator Sets	84	0.74	g/hp-hr
2023	Graders	Graders	175	0.41	g/hp-hr
2023	Off-Highway Trucks	Off-Highway Trucks	400	0.38	g/hp-hr
2023	Other Construction Equipment	Other Construction Equipment	172	0.42	g/hp-hr
2023	Other General Industrial Equipment	Other General Industrial Equipment	88	0.34	g/hp-hr
2023	Pavers	Pavers	126	0.42	g/hp-hr
2023	Rollers	Rollers	81	0.38	g/hp-hr
2023	Rubber Tired Dozers	Rubber Tired Dozers	255	0.40	g/hp-hr
2023	Skid Steer Loaders	Skid Steer Loaders	65	0.37	g/hp-hr
2023	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	98	0.37	g/hp-hr

**Construction Offroad Engine
Characteristics and Emission**

Table B1.13. Factors

Year	Offroad2011 Equipment Category	Emission Factors, Unmitigated									
		PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
2021	Generator Sets	0.0089	0.0082	0.0089	0.8725	0.0028	2.9850	0.0514	300.1804	0.0169	0.0075
2021	Graders	0.0096	0.0088	0.0096	0.3189	0.0050	4.9648	0.0710	529.2991	0.0299	0.0133
2021	Off-Highway Trucks	0.0109	0.0100	0.0109	0.3487	0.0050	5.1111	0.1081	533.8080	0.0301	0.0134
2021	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	4.6142	0.4000	525.0843	0.0296	0.0132
2021	Other General Industri	0.0189	0.0174	0.0189	1.5936	0.0050	5.7620	0.1093	532.2543	0.0300	0.0133
2021	Pavers	0.0094	0.0086	0.0094	0.7039	0.0049	4.9599	0.0700	527.1013	0.0297	0.0132
2021	Rollers	0.0177	0.0163	0.0177	1.5829	0.0049	5.4702	0.0823	526.7951	0.0297	0.0132
2021	Rubber Tired Dozers	0.0106	0.0097	0.0106	0.5196	0.0050	2.8004	0.1082	532.0383	0.0300	0.0133
2021	Skid Steer Loaders	0.0146	0.0134	0.0146	1.5447	0.0050	5.2753	0.0805	530.2132	0.0299	0.0133
2021	Tractors/Loaders/Back	0.0156	0.0144	0.0156	1.5202	0.0050	5.5443	0.0990	531.3191	0.0300	0.0133
2022	Aerial Lifts	0.0120	0.0110	0.0120	1.4555	0.0050	5.0473	0.0722	529.1056	0.0298	0.0133
2022	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0046	3.7000	0.4000	494.6191	0.0279	0.0124
2022	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.3557	0.0299	0.0133
2022	Excavators	0.0101	0.0093	0.0101	0.5844	0.0050	5.0161	0.0823	532.5660	0.0300	0.0134
2022	Forklifts	0.0180	0.0166	0.0180	1.5686	0.0050	5.6738	0.1083	532.2564	0.0300	0.0133
2022	Generator Sets	0.0085	0.0078	0.0085	0.8534	0.0028	2.9800	0.0521	299.4182	0.0169	0.0075
2022	Graders	0.0096	0.0088	0.0096	0.3055	0.0050	4.9620	0.0709	530.5429	0.0299	0.0133
2022	Off-Highway Trucks	0.0109	0.0100	0.0109	0.3390	0.0050	5.1104	0.1075	533.5680	0.0301	0.0134
2022	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	524.7118	0.0296	0.0132
2022	Other General Industri	0.0181	0.0167	0.0181	1.5657	0.0050	5.7520	0.1118	532.2543	0.0300	0.0133
2022	Pavers	0.0094	0.0087	0.0094	0.6253	0.0049	4.9520	0.0686	527.2251	0.0297	0.0132
2022	Rollers	0.0164	0.0151	0.0164	1.5158	0.0049	5.4465	0.0813	526.3623	0.0297	0.0132
2022	Rubber Tired Dozers	0.0108	0.0099	0.0108	0.4880	0.0050	2.6733	0.1119	532.5007	0.0300	0.0134
2022	Skid Steer Loaders	0.0134	0.0123	0.0134	1.5025	0.0050	5.2718	0.0801	530.1570	0.0299	0.0133
2022	Tractors/Loaders/Back	0.0149	0.0137	0.0149	1.4861	0.0050	5.5346	0.0997	531.9025	0.0300	0.0133
2023	Aerial Lifts	0.0114	0.0105	0.0114	1.4132	0.0050	5.0381	0.0726	529.1057	0.0298	0.0133
2023	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0046	3.7000	0.4000	494.8436	0.0279	0.0124
2023	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.3882	0.0299	0.0133
2023	Excavators	0.0102	0.0094	0.0102	0.5303	0.0050	5.0153	0.0840	532.6568	0.0300	0.0134
2023	Forklifts	0.0180	0.0165	0.0180	1.5556	0.0050	5.6691	0.1140	532.2556	0.0300	0.0133
2023	Generator Sets	0.0085	0.0078	0.0085	0.8450	0.0028	2.9758	0.0541	300.0468	0.0169	0.0075
2023	Graders	0.0097	0.0090	0.0097	0.3025	0.0050	4.9595	0.0735	532.7912	0.0301	0.0134
2023	Off-Highway Trucks	0.0111	0.0102	0.0111	0.3420	0.0050	5.1099	0.1130	534.1735	0.0301	0.0134
2023	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	524.8453	0.0296	0.0132
2023	Other General Industri	0.0181	0.0167	0.0181	1.5597	0.0050	5.7459	0.1181	532.2543	0.0300	0.0133
2023	Pavers	0.0095	0.0088	0.0095	0.6190	0.0049	4.9450	0.0713	527.4206	0.0298	0.0132
2023	Rollers	0.0164	0.0151	0.0164	1.5079	0.0049	5.4264	0.0839	526.5172	0.0297	0.0132
2023	Rubber Tired Dozers	0.0110	0.0101	0.0110	0.4737	0.0050	2.5606	0.1182	534.1053	0.0301	0.0134
2023	Skid Steer Loaders	0.0129	0.0119	0.0129	1.4815	0.0050	5.2690	0.0817	529.9031	0.0299	0.0133
2023	Tractors/Loaders/Back	0.0150	0.0138	0.0150	1.4798	0.0050	5.5274	0.1048	532.0080	0.0300	0.0133

**Construction Offroad Engine
Characteristics and Emission**

Table B1.13. Factors

Year	Offroad2011 Equipment Category	Emission Factors, Mitigated									
		PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
2021	Generator Sets	0.0089	0.0082	0.0089	0.8725	0.0028	2.9850	0.0514	300.1804	0.0169	0.0075
2021	Graders	0.0096	0.0088	0.0096	0.3000	0.0050	3.7000	0.0710	529.2991	0.0299	0.0133
2021	Off-Highway Trucks	0.0109	0.0100	0.0109	0.3000	0.0050	2.2000	0.1081	533.8080	0.0301	0.0134
2021	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	525.0843	0.0296	0.0132
2021	Other General Industri	0.0189	0.0174	0.0189	1.5936	0.0050	5.7620	0.1093	532.2543	0.0300	0.0133
2021	Pavers	0.0094	0.0086	0.0094	0.3000	0.0049	3.7000	0.0700	527.1013	0.0297	0.0132
2021	Rollers	0.0177	0.0163	0.0177	1.5829	0.0049	3.7000	0.0823	526.7951	0.0297	0.0132
2021	Rubber Tired Dozers	0.0106	0.0097	0.0106	0.3000	0.0050	2.2000	0.1082	532.0383	0.0300	0.0133
2021	Skid Steer Loaders	0.0146	0.0134	0.0146	1.5447	0.0050	3.7000	0.0805	530.2132	0.0299	0.0133
2021	Tractors/Loaders/Back	0.0150	0.0144	0.0150	0.3000	0.0050	3.7000	0.0990	531.3191	0.0300	0.0133
2022	Aerial Lifts	0.0120	0.0110	0.0120	1.4555	0.0050	3.7000	0.0722	529.1056	0.0298	0.0133
2022	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0046	3.7000	0.4000	494.6191	0.0279	0.0124
2022	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.3557	0.0299	0.0133
2022	Excavators	0.0101	0.0093	0.0101	0.3000	0.0050	3.7000	0.0823	532.5660	0.0300	0.0134
2022	Forklifts	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.1083	532.2564	0.0300	0.0133
2022	Generator Sets	0.0085	0.0078	0.0085	0.8534	0.0028	2.9800	0.0521	299.4182	0.0169	0.0075
2022	Graders	0.0096	0.0088	0.0096	0.3000	0.0050	3.7000	0.0709	530.5429	0.0299	0.0133
2022	Off-Highway Trucks	0.0109	0.0100	0.0109	0.3000	0.0050	2.2000	0.1075	533.5680	0.0301	0.0134
2022	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	524.7118	0.0296	0.0132
2022	Other General Industri	0.0181	0.0167	0.0181	1.5657	0.0050	5.7520	0.1118	532.2543	0.0300	0.0133
2022	Pavers	0.0094	0.0087	0.0094	0.3000	0.0049	3.7000	0.0686	527.2251	0.0297	0.0132
2022	Rollers	0.0164	0.0151	0.0164	1.5158	0.0049	3.7000	0.0813	526.3623	0.0297	0.0132
2022	Rubber Tired Dozers	0.0108	0.0099	0.0108	0.3000	0.0050	2.2000	0.1119	532.5007	0.0300	0.0134
2022	Skid Steer Loaders	0.0134	0.0123	0.0134	1.5025	0.0050	3.7000	0.0801	530.1570	0.0299	0.0133
2022	Tractors/Loaders/Back	0.0149	0.0137	0.0149	0.3000	0.0050	3.7000	0.0997	531.9025	0.0300	0.0133
2023	Aerial Lifts	0.0114	0.0105	0.0114	1.4132	0.0050	3.7000	0.0726	529.1057	0.0298	0.0133
2023	Bore/Drill Rigs	0.2200	0.2200	0.2200	2.6000	0.0046	3.7000	0.4000	494.8436	0.0279	0.0124
2023	Cranes	0.2200	0.2200	0.2200	2.6000	0.0050	3.7000	0.4000	529.3882	0.0299	0.0133
2023	Excavators	0.0102	0.0094	0.0102	0.3000	0.0050	3.7000	0.0840	532.6568	0.0300	0.0134
2023	Forklifts	0.0150	0.0150	0.0150	0.3000	0.0050	3.7000	0.1140	532.2556	0.0300	0.0133
2023	Generator Sets	0.0085	0.0078	0.0085	0.8450	0.0028	2.9758	0.0541	300.0468	0.0169	0.0075
2023	Graders	0.0097	0.0090	0.0097	0.3000	0.0050	3.7000	0.0735	532.7912	0.0301	0.0134
2023	Off-Highway Trucks	0.0111	0.0102	0.0111	0.3000	0.0050	2.2000	0.1130	534.1735	0.0301	0.0134
2023	Other Construction Eq	0.2200	0.2200	0.2200	2.6000	0.0049	3.7000	0.4000	524.8453	0.0296	0.0132
2023	Other General Industri	0.0181	0.0167	0.0181	1.5597	0.0050	5.7459	0.1181	532.2543	0.0300	0.0133
2023	Pavers	0.0095	0.0088	0.0095	0.3000	0.0049	3.7000	0.0713	527.4206	0.0298	0.0132
2023	Rollers	0.0164	0.0151	0.0164	1.5079	0.0049	3.7000	0.0839	526.5172	0.0297	0.0132
2023	Rubber Tired Dozers	0.0110	0.0101	0.0110	0.3000	0.0050	2.2000	0.1182	534.1053	0.0301	0.0134
2023	Skid Steer Loaders	0.0129	0.0119	0.0129	1.4815	0.0050	3.7000	0.0817	529.9031	0.0299	0.0133
2023	Tractors/Loaders/Back	0.0150	0.0138	0.0150	0.3000	0.0050	3.7000	0.1048	532.0080	0.0300	0.0133

Notes and assumptions:

Horsepower and load factors for offroad equipment are from Offroad2011. In cases where Offroad2011 did not list the needed equipment category, CalEEMod, Appendix D, Table 3.3 Offroad Default Horsepower and Load Factors were used.

Unmitigated offroad equipment reflects the CARB fleet mix for land-based equipment and Tier 3 for barge-mounted equipment.

Table B1.14. Offroad Engine Emission Factors - USEPA Standards
Emission Factor (g/hp-hr)

	High HP	PM10	PM2.5	DPM	NOX	SOX	CO	VOC
Tier 1	49	0.6	0.6	0.6	6.2		4.1	0.9
	74	1.09	1.09	1.09	6.9		6.9	0.9
	99	1.09	1.09	1.09	6.9		6.9	0.9
	174	0.6	0.6	0.6	6.9		6.9	0.9
	299	0.4	0.4	0.4	6.9		6.9	1
	599	0.4	0.4	0.4	6.9		6.9	1
	750	0.4	0.4	0.4	6.9		6.9	1
	2000	0.4	0.4	0.4	6.9		6.9	1
Tier 2	49	0.45	0.45	0.45	4.9		4.1	1.5
	74	0.3	0.3	0.3	4.9		3.7	2.9
	99	0.3	0.3	0.3	4.9		3.7	2.9
	174	0.22	0.22	0.22	4.3		3.7	1.2
	299	0.15	0.15	0.15	4.3		2.6	2.3
	599	0.15	0.15	0.15	4.2		2.6	2.2
	750	0.15	0.15	0.15	4.2		2.6	2.2
	2000	0.15	0.15	0.15	4.2		2.6	2.2
Tier 3	49	0.45	0.45	0.45	4.9		4.1	1.5
	74	0.3	0.3	0.3	4.9		3.7	2.9
	99	0.3	0.3	0.3	3		3.7	0.5
	174	0.22	0.22	0.22	2.6		3.7	0.4
	299	0.15	0.15	0.15	2.6		2.6	0.4
	599	0.15	0.15	0.15	2.6		2.6	0.4
	750	0.15	0.15	0.15	2.6		2.6	0.4
	2000	0.15	0.15	0.15	4.2		2.6	0.6
Tier 4 Interim	49	0.22	0.22	0.22	4.9		4.1	0.7
	74	0.22	0.22	0.22	3		3.7	0.5
	99	0.015	0.015	0.015	2.5		3.7	0.14
	174	0.015	0.015	0.015	2.5		3.7	0.14
	299	0.015	0.015	0.015	1.5		2.6	0.14
	599	0.015	0.015	0.015	1.5		2.6	0.14
	750	0.015	0.015	0.015	1.5		2.6	0.14
	2000	0.07	0.07	0.07	2.6		2.6	0.3
Tier 4 Final	49	0.02	0.02	0.02	3		4.1	0.5
	74	0.02	0.02	0.02	3		3.7	0.5
	99	0.015	0.015	0.015	0.3		3.7	0.17
	174	0.015	0.015	0.015	0.3		3.7	0.14
	299	0.015	0.015	0.015	0.3		2.2	0.14
	599	0.015	0.015	0.015	0.3		2.2	0.14
	750	0.015	0.015	0.015	0.3		2.2	0.14
	2000	0.03	0.03	0.03	2.6		2.6	0.14

Source: CO emission factors are from CalEEMod, Appendix D, Table 3.5 OFFROAD Emission Factor Based on Engine Tier. SOx is a function of fuel sulfur content and does not change with mitigation.

Table B1.15. Construction Onroad Engine Characteristics and Emission Factors

Emission Factors, Unmitigated		Fleet Mix																		
Source Description	EMFAC2011 Category	Emission Factor Units	PM10				PM2.5				DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O		
			brake wear	PM10 tire wear	PM2.5 brake wear	PM2.5 tire wear	PM10	PM2.5	PM10	PM2.5										
<i>2018 Idling Onsite</i>																				
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle									0.12	0.11	0.12	52.00	0.07	35.79	6.37	6585.76	0.01	0.00
haul trucks	T6 Instate Construction Small	g/hr-vehicle									0.12	0.11	0.12	52.00	0.07	35.79	6.37	6585.76	0.01	0.00
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite																	
support vehicles	MDV	g/hr-vehicle									0.21	0.19	0.21	66.93	0.07	22.05	1.90	7088.24	0.01	0.00
<i>2018 Transit Onsite</i>																				
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.09	0.09	0.09	12.25	0.00	1.67	0.73	2294.53	0.01	0.00				
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.26	0.25	0.26	12.09	0.00	3.10	1.89	2277.40	0.01	0.00				
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.13	0.00	1.61	0.11	958.07	0.20	0.02				
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.39	0.00	3.95	0.30	1699.14	0.01	0.00				
<i>2018 Transit Offsite</i>																				
haul trucks	T6 Instate Construction Heavy	g/mi	0.13	0.01	0.06	0.00	0.03	0.03	0.03	3.84	0.01	0.27	0.08	1164.45	0.01	0.00				
haul trucks	T6 Instate Construction Small	g/mi	0.13	0.01	0.06	0.00	0.12	0.11	0.12	3.58	0.01	0.63	0.19	1163.52	0.01	0.00				
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.10	0.00	1.18	0.04	323.37	0.20	0.02				
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.10	0.00	0.91	0.04	196.10	0.01	0.00				
<i>2019 Idling Onsite</i>																				
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle									0.12	0.11	0.12	49.98	0.07	36.67	6.52	6479.21	0.01	0.00
haul trucks	T6 Instate Construction Small	g/hr-vehicle									0.12	0.11	0.12	49.98	0.07	36.67	6.52	6479.21	0.01	0.00
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite																	
support vehicles	MDV	g/hr-vehicle									0.18	0.16	0.18	63.23	0.07	22.19	1.90	6990.15	0.01	0.00
<i>2019 Transit Onsite</i>																				
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.07	0.07	0.07	11.92	0.00	1.64	0.66	2281.46	0.01	0.00				
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.19	0.19	0.19	11.38	0.00	2.73	1.54	2256.35	0.01	0.00				
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.12	0.00	1.43	0.10	930.37	0.20	0.02				
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.35	0.00	3.57	0.27	1659.70	0.01	0.00				
<i>2019 Transit Offsite</i>																				
haul trucks	T6 Instate Construction Heavy	g/mi	0.13	0.01	0.06	0.00	0.02	0.02	0.02	3.52	0.01	0.25	0.07	1157.39	0.01	0.00				
haul trucks	T6 Instate Construction Small	g/mi	0.13	0.01	0.06	0.00	0.10	0.09	0.10	3.07	0.01	0.53	0.15	1155.59	0.01	0.00				
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.09	0.00	1.06	0.04	313.06	0.20	0.02				
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.09	0.00	0.83	0.03	189.06	0.01	0.00				

Table B1.15. Construction Onroad Engine Characteristics and Emission Factors

Emission Factors, Unmitigated		Fleet Mix																
Source Description	EMFAC2011 Category	Emission Factor Units	PM10				PM2.5				DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
			PM10	PM10 tire wear	PM2.5	PM2.5 tire wear	PM10	PM2.5	PM2.5	PM2.5 tire wear								
<i>2020 Idling Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle					0.12	0.11	0.12	47.22	0.07	37.91	6.74	6338.61	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/hr-vehicle					0.12	0.11	0.12	47.22	0.07	37.91	6.74	6338.61	0.01	0.00		
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite															
support vehicles	MDV	g/hr-vehicle					0.13	0.12	0.13	56.22	0.07	22.65	1.93	6864.20	0.01	0.00		
<i>2020 Transit Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.04	0.04	0.04	11.46	0.00	1.54	0.53	2268.61	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.07	0.06	0.07	10.04	0.00	2.03	0.89	2230.01	0.01	0.00		
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.11	0.00	1.32	0.09	903.91	0.20	0.02		
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.31	0.00	3.28	0.24	1618.62	0.01	0.00		
<i>2020 Transit Offsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.13	0.01	0.06	0.00	0.02	0.02	0.02	3.16	0.01	0.21	0.06	1155.20	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.13	0.01	0.06	0.00	0.06	0.06	0.06	2.21	0.01	0.36	0.10	1151.20	0.01	0.00		
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.08	0.00	0.97	0.03	303.51	0.20	0.02		
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.08	0.00	0.76	0.03	183.35	0.01	0.00		
<i>2021 Idling Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle					0.11	0.10	0.11	43.45	0.07	39.54	7.02	6335.39	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/hr-vehicle					0.11	0.10	0.11	43.45	0.07	39.54	7.02	6335.39	0.01	0.00		
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite															
support vehicles	MDV	g/hr-vehicle					0.10	0.09	0.10	45.63	0.07	23.92	2.03	6868.91	0.01	0.00		
<i>2021 Transit Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.04	0.04	0.04	11.24	0.00	1.54	0.50	2255.51	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	8.93	0.00	1.28	0.28	2199.95	0.01	0.00		
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.10	0.00	1.24	0.08	877.42	0.20	0.02		
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.28	0.00	2.88	0.21	1571.37	0.01	0.00		
<i>2021 Transit Offsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.13	0.01	0.06	0.00	0.02	0.01	0.02	2.89	0.01	0.21	0.06	1153.56	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.13	0.01	0.06	0.00	0.00	0.00	0.00	1.41	0.01	0.17	0.04	1149.57	0.01	0.00		
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.07	0.00	0.91	0.03	294.47	0.20	0.02		
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.07	0.00	0.68	0.03	178.16	0.01	0.00		

Table B1.15. Construction Onroad Engine Characteristics and Emission Factors

Emission Factors, Unmitigated		Fleet Mix																
Source Description	EMFAC2011 Category	Emission Factor Units	PM10				PM2.5				DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
			brake wear	PM10 tire wear	brake wear	PM2.5 tire wear	PM10	PM2.5	PM10	PM2.5								
<i>2022 Idling Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle																
	T6 Instate Construction																	
haul trucks	Small	g/hr-vehicle																
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite															
support vehicles	MDV	g/hr-vehicle																
<i>2022 Transit Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.03	0.03	0.03	11.04	0.00	1.54	0.47	2241.17	0.01	0.00		
	T6 Instate Construction																	
haul trucks	Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	9.14	0.00	1.29	0.28	2190.34	0.01	0.00		
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.09	0.00	1.17	0.07	851.21	0.20	0.02		
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.25	0.00	2.40	0.17	1522.06	0.01	0.00		
<i>2022 Transit Offsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.13	0.01	0.06	0.00	0.01	0.01	0.01	2.61	0.01	0.21	0.06	1149.82	0.01	0.00		
	T6 Instate Construction																	
haul trucks	Small	g/mi	0.13	0.01	0.06	0.00	0.00	0.00	0.00	1.38	0.01	0.17	0.04	1145.38	0.01	0.00		
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.06	0.00	0.85	0.03	284.98	0.20	0.02		
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.06	0.00	0.60	0.02	173.01	0.01	0.00		
<i>2023 Idling Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle																
	T6 Instate Construction																	
haul trucks	Small	g/hr-vehicle																
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite															
support vehicles	MDV	g/hr-vehicle																
<i>2023 Transit Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	9.53	0.00	1.33	0.26	2211.74	0.01	0.00		
	T6 Instate Construction																	
haul trucks	Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	9.11	0.00	1.21	0.23	2163.36	0.01	0.00		
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.08	0.00	1.10	0.07	825.59	0.20	0.02		
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.22	0.00	2.16	0.16	1470.98	0.01	0.00		
<i>2023 Transit Offsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.13	0.01	0.06	0.00	0.00	0.00	0.00	1.20	0.01	0.17	0.03	1151.59	0.01	0.00		
	T6 Instate Construction																	
haul trucks	Small	g/mi	0.13	0.01	0.06	0.00	0.00	0.00	0.00	1.11	0.01	0.16	0.03	1134.15	0.01	0.00		
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.06	0.00	0.80	0.02	275.64	0.20	0.02		
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.06	0.00	0.55	0.02	168.15	0.01	0.00		

Table B1.15. Construction Onroad Engine Characteristics and Emission Factors

Emission Factors, Unmitigated		Fleet Mix															
Source Description	EMFAC2011 Category	Emission Factor Units	Emission				PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O	
			PM10 brake wear	PM10 tire wear	PM2.5 brake wear	PM2.5 tire wear											
Emission Factors, Mitigated		2010+ MY															
		Emission				PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O		
		PM10 brake wear	PM10 tire wear	PM2.5 brake wear	PM2.5 tire wear												
<i>2018 Idling Onsite</i>																	
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	7142.02	0.01	0.00	
haul trucks	T6 Instate Construction Small	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	7142.02	0.01	0.00	
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite														
support vehicles	MDV	g/hr-vehicle					0.21	0.19	0.21	66.93	0.07	22.05	1.90	7088.24	0.01	0.00	
<i>2018 Transit Onsite</i>																	
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	7.94	0.00	1.24	0.27	2242.29	0.01	0.00	
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	7.79	0.00	1.22	0.26	2239.61	0.01	0.00	
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.13	0.00	1.61	0.11	958.07	0.20	0.02	
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.39	0.00	3.95	0.30	1699.14	0.01	0.00	
<i>2018 Transit Offsite</i>																	
haul trucks	T6 Instate Construction Heavy	g/mi	0.13	0.01	0.06	0.00	0.00	0.00	0.00	1.15	0.01	0.16	0.03	1151.86	0.01	0.00	
haul trucks	T6 Instate Construction Small	g/mi	0.13	0.01	0.05	0.00	0.00	0.00	0.00	1.21	0.01	0.16	0.03	1145.87	0.01	0.00	
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.10	0.00	1.18	0.04	323.37	0.20	0.02	
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.10	0.00	0.91	0.04	196.10	0.01	0.00	
<i>2019 Idling Onsite</i>																	
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	7027.44	0.01	0.00	
haul trucks	T6 Instate Construction Small	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	7027.44	0.01	0.00	
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite														
support vehicles	MDV	g/hr-vehicle					0.18	0.16	0.18	63.23	0.07	22.19	1.90	6990.15	0.01	0.00	
<i>2019 Transit Onsite</i>																	
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	8.29	0.00	1.27	0.27	2231.67	0.01	0.00	
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	8.10	0.00	1.23	0.25	2220.94	0.01	0.00	
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.12	0.00	1.43	0.10	930.37	0.20	0.02	
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.35	0.00	3.57	0.27	1659.70	0.01	0.00	
<i>2019 Transit Offsite</i>																	
haul trucks	T6 Instate Construction Heavy	g/mi	0.12	0.01	0.05	0.00	0.00	0.00	0.00	1.11	0.01	0.15	0.03	1097.19	0.01	0.00	
haul trucks	T6 Instate Construction Small	g/mi	0.12	0.01	0.05	0.00	0.00	0.00	0.00	1.12	0.01	0.15	0.03	1095.82	0.01	0.00	
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.09	0.00	1.06	0.04	313.06	0.20	0.02	
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.09	0.00	0.83	0.03	189.06	0.01	0.00	

Table B1.15. Construction Onroad Engine Characteristics and Emission Factors

Emission Factors, Unmitigated		Fleet Mix																
Source Description	EMFAC2011 Category	Emission Factor Units	PM10				PM2.5				DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
			PM10	PM10 tire wear	PM2.5	PM2.5 tire wear	PM10	PM2.5	PM2.5	PM2.5 tire wear								
<i>2020 Idling Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	6874.67	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	6874.67	0.01	0.00		
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite															
support vehicles	MDV	g/hr-vehicle					0.13	0.12	0.13	56.22	0.07	22.65	1.93	6864.20	0.01	0.00		
<i>2020 Transit Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	8.61	0.00	1.29	0.28	2224.29	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	8.41	0.00	1.23	0.25	2204.80	0.01	0.00		
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.11	0.00	1.32	0.09	903.91	0.20	0.02		
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.31	0.00	3.28	0.24	1618.62	0.01	0.00		
<i>2020 Transit Offsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.12	0.01	0.05	0.00	0.00	0.00	0.00	1.20	0.01	0.15	0.03	1089.90	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.13	0.01	0.06	0.00	0.00	0.00	0.00	1.12	0.01	0.16	0.03	1167.09	0.01	0.00		
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.08	0.00	0.97	0.03	303.51	0.20	0.02		
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.08	0.00	0.76	0.03	183.35	0.01	0.00		
<i>2021 Idling Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	6874.67	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	6874.67	0.01	0.00		
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite															
support vehicles	MDV	g/hr-vehicle					0.10	0.09	0.10	45.63	0.07	23.92	2.03	6868.91	0.01	0.00		
<i>2021 Transit Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	8.92	0.00	1.31	0.28	2215.26	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	8.71	0.00	1.22	0.24	2192.87	0.01	0.00		
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.10	0.00	1.24	0.08	877.42	0.20	0.02		
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.28	0.00	2.88	0.21	1571.37	0.01	0.00		
<i>2021 Transit Offsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.12	0.01	0.05	0.00	0.00	0.00	0.00	1.20	0.01	0.16	0.03	1092.46	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.13	0.01	0.06	0.00	0.00	0.00	0.00	1.07	0.01	0.16	0.03	1173.45	0.01	0.00		
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.07	0.00	0.91	0.03	294.47	0.20	0.02		
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.07	0.00	0.68	0.03	178.16	0.01	0.00		

Table B1.15. Construction Onroad Engine Characteristics and Emission Factors

Emission Factors, Unmitigated		Fleet Mix		Emission Factor	PM10	PM10 tire	PM2.5	PM2.5 tire	PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O
Source Description	EMFAC2011 Category	Units	brake wear	wear	brake wear	wear	PM10	PM2.5	DPM	NOx	SOx	CO	VOC	CO2	CH4	N2O		
<i>2022 Idling Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	6874.67	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	6874.67	0.01	0.00		
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite															
support vehicles	MDV	g/hr-vehicle					0.10	0.09	0.10	41.05	0.07	24.86	2.11	6864.99	0.01	0.00		
<i>2022 Transit Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	9.20	0.00	1.33	0.28	2205.86	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	8.96	0.00	1.24	0.25	2184.02	0.01	0.00		
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.09	0.00	1.17	0.07	851.21	0.20	0.02		
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.25	0.00	2.40	0.17	1522.06	0.01	0.00		
<i>2022 Transit Offsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.12	0.01	0.05	0.00	0.00	0.00	0.00	1.18	0.01	0.16	0.03	1101.98	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.13	0.01	0.06	0.00	0.00	0.00	0.00	1.08	0.01	0.16	0.03	1160.81	0.01	0.00		
worker vehicles	LDA	g/mi	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.06	0.00	0.85	0.03	284.98	0.20	0.02		
support vehicles	MDV	g/mi	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.06	0.00	0.60	0.02	173.01	0.01	0.00		
<i>2023 Idling Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	6874.67	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/hr-vehicle					0.09	0.08	0.09	38.41	0.07	25.42	2.15	6874.67	0.01	0.00		
worker vehicles	LDA	g/hr-vehicle	worker vehicles do not idle onsite															
support vehicles	MDV	g/hr-vehicle					0.09	0.09	0.09	40.69	0.07	24.90	2.11	6867.19	0.01	0.00		
<i>2023 Transit Onsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	9.47	0.00	1.33	0.25	2210.93	0.01	0.00		
haul trucks	T6 Instate Construction Small	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	9.09	0.00	1.21	0.23	2162.95	0.01	0.00		
worker vehicles	LDA	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.08	0.00	1.10	0.07	825.59	0.20	0.02		
support vehicles	MDV	g/mi	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.22	0.00	2.16	0.16	1470.98	0.01	0.00		
<i>2023 Transit Offsite</i>																		
haul trucks	T6 Instate Construction Heavy	g/mi	0.119	0.011	0.051	0.003	0.003	0.003	0.003	1.261	0.010	0.167	0.032	1074.817	0.005	0.005		
haul trucks	T6 Instate Construction Small	g/mi	0.130	0.012	0.056	0.003	0.003	0.003	0.003	1.064	0.011	0.160	0.030	1132.138	0.005	0.005		
worker vehicles	LDA	g/mi	0.036	0.008	0.016	0.002	0.002	0.002	0.002	0.058	0.003	0.799	0.023	275.644	0.202	0.022		
support vehicles	MDV	g/mi	0.012	0.003	0.005	0.001	0.001	0.001	0.001	0.056	0.002	0.546	0.021	168.151	0.005	0.005		

Notes:

Criteria pollutant and CO2 emission factors were obtained by running EMFAC2014.

CH4 and N2O emission factors were obtained from the 2015 Climate Registry Default Emission Factors, Table 13.4, Default CH4 and N2O Emission Factors for Highway Vehicles by Technology Type.

Table B1.16. Paved Road Dust Emission Factors

Emission Source	(K)	(K)	(W)	(E)	(E)	
	Particle Size (sL) Multiplier - Silt Loading (g/m ²)	Particle Size Multiplier - PM10 (g/VMT)	Particle Size Multiplier - PM2.5 (g/VMT)	Average Vehicle Weight on Road (tons)	Uncontrolled PM10 Emission Factor (g/VMT)	Uncontrolled PM2.5 Emission Factor (g/VMT)
Onsite Trucks	0.135	1.00	0.15	25.0	4.31	0.65
Onsite Autos	0.135	1.00	0.15	2.4	0.39	0.06
Local Collector	0.135	1.00	0.15	2.4	0.39	0.06
Major Freeway	0.013	1.00	0.15	2.4	0.05	0.01
Freeway	0.015	1.00	0.15	2.4	0.05	0.01

Notes:

- Source: CARB Emission Inventory Chapter 7.9: Miscellaneous Process Methodology. Entrained Road Travel, Paved Road Dust. https://www.arb.ca.gov/ei/areasrc/fullpdf/full7-9_2016.pdf. November 2016.
- Emission factors exclude engine exhaust, tire wear, and brake wear.
- The equation is: Emission Factor = (Particle Size Multiplier) x (sL)^{0.91} x (Vehicle Weight)^{1.02}
- The silt loading value of 0.135 g/m² for local roadways was assumed to be representative of onsite conditions because of the relatively low number of onsite truck and automobile trips.
- The average vehicle weight for onsite trucks is based on a modern tanker truck that holds 9,000 gal diesel fuel (approx. 31.7 tons fuel) and has a GVWR of 80,000 lbs (40 tons) (GVWR includes the weight of cargo). Therefore, a loaded fuel truck would weigh 40 tons and an empty fuel truck would weigh 8.3 tons. The average weight is therefore assumed to be approximately 25 tons. Trucks and autos would generally take different routes onsite.

Summary of Daily VMT by Roadway Type

Los Angeles - Long Beach - Santa Ana Metro Area

Metropolitan Area	Interstate/ Other Fwy/ Exprwy	Other Principal Arterial	Minor Arterial	Collector	Local
Daily Vehicle-Miles Travelled (Thousands)	132,168	69,417	48,441	11,845	13,794
Travel Fraction	0.48	0.25	0.18	0.04	0.05

Source: Federal Highway Administration. Highway Statistics 2008 - Urbanized Areas - 2008 Miles and Daily Vehicle Miles Traveled. Table HM-71.

October 2009. website: <http://www.fhwa.dot.gov/policyinformation/statistics/2008/hm71.cfm>.

Composite Paved Road Dust Emission Factors for Project Trips

Road Type	Fraction of Travel by Roadway Type					Composite EF	
	Interstate/ Other Fwy/ Exprwy	Other Principal Arterial	Minor Arterial	Collector	Local	PM10 (g/VMT)	PM2.5 (g/VMT)
Vehicle Trips in Los Angeles - Long Beach - Santa Ana Metro Area	0.48	0.25	0.18	0.04	0.05	0.19	0.05

Table B1.17. Material Loading/Handling Dust Emission Factors

PM10 (lb/ton)	0.0000888
PM2.5 (lb/ton)	0.0000134
$EF = (k)(0.0032)[(U/5)^{1.3}]/[(M/2)^{1.4}]$ EF = lb/ton k = Particle Size Constant (0.35 for PM10 and 0.053 for PM2.5) U = average wind speed = 2.2 m/s (CalEEMod), 4.9 mph M = moisture content = 12% (CalEEMod)	
Soil density (ton/cyd):	1.26
Truck capacity (cyd)	20
Truck capacity (ton)	25.28

Source: AP-42, p. 13.2.4 & CalEEMod

Table B1.18. Grading Dust Emission Factors

PM10 (lb/VMT)	1.543 PM10 (lb/acre)	1.06
PM2.5 (lb/VMT)	0.167 PM2.5 (lb/acre)	0.11
$E \text{ (lb/VMT)} = k \times 0.051 \times (S)^{2.0}$ for PM10 and $k \times 0.040 \times (S)^{2.5}$ for PM2.5 k = Scaling Constant (0.60 for PM10 and 0.031 for PM2.5) S = Mean Vehicle Speed assumed to be 7.1 mph Assumes VMT = 3 x hours in use $E = EF \times VMT$ $VMT = \text{Acres graded} / Wb \times 43560(\text{sft/acre}) / 5280(\text{ft/mile})$ 0.6875 VMT/acre Wb = blade width of grading equipment = 12 ft		

Source: AP42 11.9 & CalEEMod

Table B1.19. Demolition Dust Emission Factors

PM10 (lb/ton)	0.0011
PM2.5 (lb/ton)	0.00017
$EF = (k)(0.0032)[(U/5)^{1.3}]/[(M/2)^{1.4}]$ EF = lb/ton of debris k = Particle Size Constant (0.35 for PM10 and 0.053 for PM2.5) U = average wind speed = 2.2 m/s (CalEEMod), 4.9 mph M = moisture content = 2% (CalEEMod)	

Source: CalEEMod

Table B1.20. Debris Loading Dust Emission Factors

PM10 (lb/ton)	0.0203
PM2.5 (lb/ton)	0.0031
$EF = k \times 0.058$ EF = lb/ton of debris k = Particle Size Constant (0.35 for PM10 and 0.053 for PM2.5)	

Source: CalEEMod

Table B1.21. Fugitive Dust Control

Regulatory Requirement ^[1]	61% Water disturbed areas within the construction site: 2x/day (3.2-hour watering interval). SCAQMD Rule 403 36% Demolition debris removal: Water every 4 hours within 100 feet of a structure being demolished. SCAQMD
Source: [1] SCAQMD Rule 403, as applicable for Small Projects (<50 acres disturbed, <5,000 yd ³ 3 times per year).	

Table B1.22. GHG Emission Factors

	CO2	CH4	N2O	Fuel
	(kg CO2/gal fuel)	(kg CH4/gal fuel)	(kg N2O/gal fuel)	
offroad construction equipment[1],[2]	10.21	0.000576	0.000256	diesel
	(kg CO2/gal fuel)	(g CH4/mile)	(g N2O/mile)	
onroad medium and heavy duty vehicles[1],[3]	10.21	0.0051	0.0048	diesel
onroad light duty vehicles[1],[3]	8.78	0.2024	0.022	gasoline
	kg CO2/gal	kg/MMBtu	kg/MMBtu	
non-transport fuel combustion[4],[5]	5.72	0.003	0.0006	propane
	kg CO2/MMBtu	kg/MMBtu	kg/MMBtu	
non-transport fuel combustion[4],[5]	53.06	0.001	0.0001	natural gas

Notes:

[1] CO2 emission factors: 2016 Climate Registry Default Emission Factors, Table 13.1, US Default CO2 Emission Factors for Transport Fuels

[2] N2O and CH4 emission factors: 2016 Climate Registry Default Emission Factors, Table 13.7, Default CH4 and N2O Emission Factors for Non-Highway Vehicles.

[3] N2O and CH4 emission factors: 2016 Climate Registry Default Emission Factors, Table 13.4, Default CH4 and N2O Emission Factors for Highway Vehicles by Technology Type.

[4] CO2 emission factors: 2016 Climate Registry Default Emission Factors, Table 12.1, Default Factors for Calculating CO2 Emissions from Fossil Fuel and Biomass Combustion

[5] CH4 and N2O emission factors: 2016 Climate Registry Default Emission Factors, Table 12.9.1, Default CH4 and N2O Emission Factors by Fuel Type, Industrial and Energy Sectors

Table B1.23. Fuel Density

Diesel (lb/gal)	7.04
Gasoline (lb/gal)	6.15

Table B1.24. Global Warming Potentials (GWP)

CO2	CH4	N2O
1	28	265

IPCC 2015. Intergovernmental Panel on Climate Change. 5th Assessment Report.

Table B1.25 Operational Peak Daily Emissions Summary

Year	Source	Peak Daily Operational Emissions					
		PM10 (lb/day)	PM2.5 (lb/day)	NOx (lb/day)	SOx (lb/day)	CO (lb/day)	VOC (lb/day)
2011 - 2015	Ships Transit and Anchoring	23.3	21.5	1,980.2	44.6	185.0	83.4
2011 - 2015	Ships Hotelling	31.7	29.4	364.1	121.4	33.4	13.7
2011 - 2015	Tugs	4.4	4.1	231.3	0.0	22.4	8.0
2011 - 2015	Tanks/Fugitives	-	-	-	-	-	15.8
2011 - 2015	Loading - VRU	-	-	-	-	-	-
2011 - 2015	Loading - Mobile/Fugitives	-	-	-	-	-	-
2011 - 2015	Total	59.5	55.0	2,575.6	166.1	240.8	121.0
2019	Ships Transit and Anchoring	78.4	72.4	4,455.6	129.2	384.3	172.8
2019	Ships Hotelling	26.8	24.8	1,057.7	71.8	87.0	34.8
2019	Tugs	5.2	4.8	254.6	0.1	24.7	8.8
2019	Tanks/Fugitives	-	-	-	-	-	15.8
2019	Loading - VRU	0.9	0.9	40.7	14.6	10.2	46.2
2019	Loading - Mobile/Fugitives	0.1	0.1	4.3	-	0.6	0.8
2019	Total	111.4	102.9	5,812.9	215.9	506.8	279.2
2031	Ships Transit and Anchoring	78.4	72.4	3,610.3	129.2	384.3	172.8
2031	Ships Hotelling	26.8	24.8	680.3	71.8	87.0	34.8
2031	Tugs	1.5	1.5	41.8	0.1	103.6	5.2
2031	Tanks/Fugitives	-	-	-	-	-	15.8
2031	Loading - VRU	0.9	0.9	40.7	14.6	10.2	46.2
2031	Loading - Mobile/Fugitives	0.1	0.1	4.3	-	0.6	0.8
2031	Total	107.7	99.6	4,377.4	215.8	585.7	275.6
2047	Ships Transit and Anchoring	78.4	72.4	2,580.2	129.2	384.3	172.8
2047	Ships Hotelling	26.8	24.8	308.5	71.8	87.0	34.8
2047	Tugs	1.5	1.5	41.8	0.1	103.6	5.2
2047	Tanks/Fugitives	-	-	-	-	-	15.9
2047	Loading - VRU	0.9	0.9	40.7	14.6	10.2	46.2
2047	Loading - Mobile/Fugitives	0.1	0.1	4.3	-	0.6	0.8
2047	Total	107.7	99.6	2,975.5	215.8	585.7	275.6

Future Years Assume:

- 1 Chemical Tanker hotelling at berth, then transit beyond SCAB
- 1 Chemical Tanker transit from beyond SCAB to berth, then hotelling at berth
- 1 Panamax Tanker transit from beyond SCAB to anchorage, then hotelling at anchorage
- 1 ITB hotelling at anchorage, then transit beyond SCAB

Table B1.26 Operational Peak Daily Emissions Summary (Reduced Project Scenario: One Berth)

Year	Source	Peak Daily Operational Emissions					
		PM10 (lb/day)	PM2.5 (lb/day)	NOx (lb/day)	SOx (lb/day)	CO (lb/day)	VOC (lb/day)
2011 - 2015	Ships Transit and Anchoring	23.3	21.5	1,980.2	44.6	185.0	83.4
2011 - 2015	Ships Hotelling	31.7	29.4	-	121.4	33.4	13.7
2011 - 2015	Tugs	4.4	4.1	231.3	0.0	22.4	8.0
2011 - 2015	Tanks/Fugitives	-	-	-	-	-	15.8
2011 - 2015	Loading - VRU	-	-	-	-	-	-
2011 - 2015	Loading - Mobile/Fugitives	-	-	-	-	-	-
2011 - 2015	Total	59.5	55.0	2,211.5	166.1	240.8	121.0
2019	Ships Transit and Anchoring	75.8	70.0	4,340.7	131.2	367.9	163.1
2019	Ships Hotelling	26.0	24.1	592.7	95.9	56.1	24.4
2019	Tugs	4.1	3.8	200.7	0.1	19.4	6.9
2019	Tanks/Fugitives	-	-	-	-	-	15.8
2019	Loading - VRU	0.9	0.9	40.7	14.6	10.2	46.2
2019	Loading - Mobile/Fugitives	0.1	0.1	4.3	-	0.6	0.8
2019	Total	106.9	98.9	5,179.1	241.8	454.3	257.3
2023	Ships Transit and Anchoring	75.8	70.0	4,340.7	131.2	367.9	163.1
2023	Ships Hotelling	26.0	24.1	592.7	95.9	56.1	24.4
2023	Tugs	1.2	1.1	32.9	0.1	81.6	4.1
2023	Tanks/Fugitives	-	-	-	-	-	15.8
2023	Loading - VRU	0.9	0.9	40.7	14.6	10.2	46.2
2023	Loading - Mobile/Fugitives	0.1	0.1	4.3	-	0.6	0.8
2023	Total	104.0	96.2	5,011.3	241.8	516.5	254.5
2031	Ships Transit and Anchoring	75.8	70.0	3,217.2	131.2	367.9	163.1
2031	Ships Hotelling	26.0	24.1	592.7	95.9	56.1	24.4
2031	Tugs	1.2	1.1	32.9	0.1	81.6	4.1
2031	Tanks/Fugitives	-	-	-	-	-	15.8
2031	Loading - VRU	0.9	0.9	40.7	14.6	10.2	46.2
2031	Loading - Mobile/Fugitives	0.1	0.1	4.3	-	0.6	0.8
2031	Total	104.0	96.2	3,887.9	241.8	516.5	254.5
2047	Ships Transit and Anchoring	75.8	70.0	1,946.5	131.2	367.9	163.1
2047	Ships Hotelling	26.0	24.1	548.4	95.9	56.1	24.4
2047	Tugs	1.2	1.1	32.9	0.1	81.6	4.1
2047	Tanks/Fugitives	-	-	-	-	-	15.9
2047	Loading - VRU	0.9	0.9	40.7	14.6	10.2	46.2
2047	Loading - Mobile/Fugitives	0.1	0.1	4.3	-	0.6	0.8
2047	Total	104.0	96.2	2,572.9	241.8	516.5	254.6

Future Years Assume:

- 1 Chemical Tanker hotelling at anchorage, then transit beyond SCAB
- 1 Chemical Tanker transit from beyond SCAB to anchorage, then hotelling at anchorage
- 1 Panamax Tanker hotelling at berth, then transit beyond SCAB
- 1 ITB hotelling at anchorage

Table B1.27 Assumptions for CEQA Max Day Scenario for 2011 - 2015 Baseline

Category	Vessel Name	Main Tier	Rating Main kW	Aux Tier	Berth Hotel Aux kW	Anch Hotel Aux kW	Maneuver Aux kW	Sea Aux kW	Berth Hotel Pump kW	Berth Hotel Boiler kW	Anch Hotel Boiler kW	Maneuver Boiler kW	Max Rated Speed	Activity	Rt
Oct 15, 2011 11 am to Oct 16, 2011 11 am															
Tanker - Panamax	Vinalines Glory	Tier 1	8061	Tier 1	623	561	763	561	0	3293	371	371	14.9	Departure	W
Tanker - Handysize	Ceylon	Tier 1	9481	Tier 1	820	537	601	537	0	2586	371	371	15.1	Shift	
Subtotal															
Vinalines Glory: 168, Anc, Depart; Ceyon: Anc, 168															
Nov 19, 2015 1 am to Nov 20, 2015 1 am															
Tanker - Chemical	Hyundai Mipo 2393	Tier 2	7700	Tier 2	816	658	890	658	0	821	371	371	15	Arrival	S
ITB	650-2 (Gulf Reliance)	Tier 1	6825	Tier 1	102	79	208	79	195	0	0	0	13.5	Arrival	W
Tanker - Chemical	Star Osprey	Tier 1	9480	Tier 1	816	658	890	658	0	821	371	371	14.2	Departure	S
Subtotal:															
Hyundai Mipo 2393: Arrival to Anc; Gulf Reliance: Arrival to 168; Star Osprey: Shift 169 to Anc, Depart															
Nov 11, 2011 2 pm to Nov 12, 2011 2 pm															
Tanker - Chemical	Oregon Voyager	Tier 0	9848	Tier 0	816	658	890	658	0	821	371	371	16	Shift	
Tanker - Panamax	Elegant Victoria	Tier 1	12240	Tier 1	623	561	763	561	0	3293	371	371	15.6	Shift	
ITB	550-3 (Ocean Reliance)	Tier 1	6767	Tier 1	102	79	190	79	195	0	0	0	13.5	Arrival	W
Subtotal:															
Max:															

Berth	Berth Hotel Time hr	Anchorage Hotel Time hr	Zone 1: Harbor			Vessel Zone 1 Time hr	Tug Zone 1 Time hr	Zone 2: BW to PZ			Vessel Zone 2 Time hr	Tug Zone 2 Time hr	Vessel	Vessel	Pump Emission Factor
			Zone 1 Speed nm/hr	Zone 1 Load	Zone 1 Distance nm			Zone 2 Speed nm/hr	Zone 2 Load	Zone 2 Distance nm			Propulsion Emission Factor	Aux Eng Emission Factor	
Anc-G5	17.88	1.00	8	0.15	3.7	0.46	1.25	9	0.22	9.58	1.06	1.35	SSD_1_.1S	AMSD_1_.1S	AHSD_1_.1S
168	5.65	17.50	5	0.04	3.7	0.74	1.25	9	0.21	1	0.11	0.60	SSD_1_.1S	AMSD_1_.1S	AHSD_1_.1S
Anc-D8		7.75					0.50	9	0.22	8.47	0.94	0.75	SSD_2_.1S	AMSD_2_.1S	AHSD_1_.1S
168	10.25		5	0.05	3.7	0.74	1.25	9	0.30	8.58	0.95	0.50	MSD_1_.1S	AHSD_1_.1S	AHSD_1_.1S
Anc-B6	11.67	7.53	5	0.04	3.7	0.74	1.25	9	0.25	8.36	0.93	1.35	SSD_1_.1S	AMSD_1_.1S	AHSD_1_.1S
168		24.00											SSD_2_.1S	AMSD_0_.1S	AHSD_1_.1S
Anc-B11	24.00												SSD_1_.1S	AMSD_1_.1S	AHSD_1_.1S
Anc-B5		5.50					0.50	9	0.30	8.58	0.95	0.75	MSD_1_.1S	AHSD_1_.1S	AHSD_1_.1S

Zone 3: PZ to 20 nm				Zone 4: 20 nm to 40 nm				Zone 5: 40 nm to SCAB OW				Tug	Tug	Tugs	Main	Load	Total
Zone 3	Zone 3	Zone 3	Zone 3	Zone 4	Zone 4	Zone 4	Zone 4	Zone 5	Zone 5	Zone 5	Zone 5	Main	Rating	per	Engines	Main	Rating
Speed	Load	Distance	Time	Speed	Load	Distance	Time	Speed	Load	Distance	Time	Tier	Main	Vessel	per Tug	Engines	Main
nm/hr		nm	hr	nm/hr		nm	hr	nm/hr		nm	hr		kW				kW
13.0	0.66	18.97	1.46	13.0	0.66	21.12	1.62	13.8	0.80	7	0.51	Tier 1	1423	2	2	0.31	1765
												Tier 1	1423	2	2	0.31	1765
11.0	0.39	11.11	1.01	12.0	0.51	20.18	1.68	13.9	0.80	3	0.22	Tier 1	1423	2	2	0.31	1765
11.0	0.54	18.97	1.72	11.0	0.54	21.12	1.92	12.5	0.80	7	0.56	Tier 1	1423	1	2	0.31	882
11.0	0.46	12.55	1.14	11.3	0.51	19.92	1.76	13.2	0.80	3	0.23	Tier 1	1423	2	2	0.31	1765
												Tier 1	1423	2	2	0.31	1765
												Tier 1	1423	2	2	0.31	1765
10.3	0.44	18.97	1.85	10.3	0.45	21.12	2.04	12.5	0.80	7	0.56	Tier 1	1423	1	2	0.31	882

Tug Aux Tier	Rating Aux kW	Aux Engines per Tug	Load Aux Engines	Total Rating Aux kW	All Zones Total						All Zones Ships Hotelling					
					PM10 (lb)	PM2.5 (lb)	NOx (lb)	SOx (lb)	CO (lb)	VOC (lb)	PM10 (lb)	PM2.5 (lb)	NOx (lb)	SOx (lb)	CO (lb)	VOC (lb)
Tier 2	136	2	0.43	234	42.12	38.98	1,569.57	113.99	143.32	62.13	24.56	22.77	559.31	90.49	52.98	23.07
Tier 2	136	2	0.43	234	17.36	16.06	603.64	44.00	57.97	24.30	7.16	6.64	188.99	24.34	17.67	7.46
					59.49	55.05	2,173.21	158.00	201.29	86.43	31.73	29.41	748.30	114.83	70.66	30.53
Tier 2	136	2	0.43	234	13.72	12.67	650.19	22.47	64.56	27.36	-	-	-	-	-	-
Tier 2	136	2	0.43	117	13.65	12.60	623.41	21.40	56.63	26.52	1.74	1.61	65.75	3.09	6.04	2.83
Tier 2	136	2	0.43	234	27.26	25.18	1,302.02	50.43	119.60	51.29	8.42	7.78	298.37	22.54	27.32	10.91
					54.63	50.45	2,575.63	94.29	240.78	105.16	10.16	9.39	364.11	25.63	33.36	13.74
Tier 2	136	2	0.43	234	11.80	10.91	519.70	27.99	42.22	16.59	-	-	-	-	-	-
Tier 2	136	2	0.43	234	32.96	30.56	750.61	121.44	71.11	30.96	32.96	30.56	750.61	121.44	71.11	30.96
Tier 2	136	2	0.43	117	10.64	9.82	496.21	16.65	44.98	21.15	-	-	-	-	-	-
					55.41	51.29	1,766.53	166.08	158.30	68.69	32.96	30.56	750.61	121.44	71.11	30.96
					59.49	55.05	2,575.63	166.08	240.78	105.16						

All Zones Tugs						All Zones Ships Transit and Anchoring					
PM10 (lb)	PM2.5 (lb)	NOx (lb)	SOx (lb)	CO (lb)	VOC (lb)	PM10 (lb)	PM2.5 (lb)	NOx (lb)	SOx (lb)	CO (lb)	VOC (lb)
2.59	2.39	127.30	0.07	12.33	4.40	14.97	13.82	882.96	23.43	78.00	34.66
1.84	1.70	90.58	0.05	8.77	3.13	8.36	7.72	324.06	19.61	31.52	13.71
4.43	4.09	217.88	0.13	21.11	7.53	23.33	21.55	1,207.03	43.04	109.53	48.37
1.24	1.15	61.20	0.04	5.93	2.11	12.48	11.52	588.99	22.43	58.63	25.24
0.87	0.80	42.84	0.03	4.15	1.48	11.03	10.19	514.82	18.29	46.44	22.22
2.59	2.39	127.30	0.07	12.33	4.40	16.25	15.01	876.36	27.81	79.95	35.97
4.71	4.34	231.34	0.14	22.41	7.99	39.76	36.71	1,980.17	68.53	185.02	83.43
-	-	-	-	-	-	11.80	10.91	519.70	27.99	42.22	16.59
-	-	-	-	-	-	-	-	-	-	-	-
0.62	0.57	30.60	0.02	2.96	1.06	10.02	9.25	465.61	16.63	42.01	20.09
0.62	0.57	30.60	0.02	2.96	1.06	21.82	20.16	985.31	44.62	84.23	36.68

Table B1.28 Propulsion Engine Emission Factors and Assumptions

Engine Type	Tier	Model	Fuel	PM10 (g/kW-hr)	PM2.5 (g/kW-hr)	DPM (g/kW-hr)	NOx (g/kW-hr)	SOx (g/kW-hr)	CO (g/kW-hr)	HC (g/kW-hr)	VOC (g/kW-hr)	CO2 (g/kW-hr)	N2O (g/kW-hr)	CH4 (g/kW-hr)	
Slow Speed Diesel	Tier 0	<=1999	0.1%S	SSD_0_.1S	0.26	0.24	0.26	17.00	0.39	1.4	0.6	0.632	589	0.029	0.012
Medium Speed Diesel	Tier 0	<=1999	0.1%S	MSD_0_.1S	0.26	0.24	0.26	13.20	0.43	1.1	0.5	0.527	649	0.029	0.010
Slow Speed Diesel	Tier 1	2000-2010	0.1%S	SSD_1_.1S	0.26	0.24	0.26	16.00	0.39	1.4	0.6	0.632	589	0.029	0.012
Medium Speed Diesel	Tier 1	2000-2010	0.1%S	MSD_1_.1S	0.26	0.24	0.26	12.20	0.43	1.1	0.5	0.527	649	0.029	0.010
Medium Speed Diesel	Tier 1	2000-2010	15 ppm S	MSD_1_ULSD	0.22	0.20	0.22	11.57	0.01	1.1	0.36	0.379	649	0.027	0.007
Slow Speed Diesel	Tier 2	2011-2015	0.1%S	SSD_2_.1S	0.26	0.24	0.26	14.40	0.39	1.4	0.6	0.632	589	0.029	0.012
Medium Speed Diesel	Tier 2	2011-2015	0.1%S	MSD_2_.1S	0.26	0.24	0.26	10.50	0.43	1.1	0.5	0.527	649	0.029	0.010
Medium Speed Diesel	Tier 2	2011-2015	15 ppm S	MSD_2_ULSD	0.22	0.204	0.22	9.95	0.006	1.1	0.36	0.379	649	0.027	0.007
Slow Speed Diesel	Tier 3	2016+	0.1%S	SSD_3_.1S	0.26	0.24	0.26	3.40	0.39	1.4	0.6	0.632	589	0.029	0.012
Medium Speed Diesel	Tier 3	2016+	0.1%S	MSD_3_.1S	0.26	0.24	0.26	2.60	0.43	1.1	0.5	0.527	649	0.029	0.010
Medium Speed Diesel	Tier 3	2016+	15 ppm S	MSD_3_ULSD	0.22	0.204	0.22	2.46	0.006	1.1	0.36	0.379	649	0.027	0.007
Medium Speed Diesel	Tier 4	2020+	15 ppm S	MSD_4_ULSD	0.04	0.04	0.04	1.8	0.006	5	0.19	0.200	652	0.031	0.004

Note: 2014 Inventory, Starcrest, Table 3.7 (Tier 0 - Tier 3, 0.1%S)

VOC = 1.053 x HC per Conversion Factors for Hydrocarbon Emission Components, EPA-420-R-10-015, July 2010.

EPA Emission Standards for Harbor Craft Emissions (Tier 4) www.epa.gov/otaq/marine.htm

	PM10 (g/kW-hr)	PM2.5 (g/kW-hr)	DPM (g/kW-hr)	NOx (g/kW-hr)	SOx (g/kW-hr)	CO (g/kW-hr)	HC (g/kW-hr)	VOC (g/kW-hr)	CO2 (g/kW-hr)	N2O (g/kW-hr)	CH4 (g/kW-hr)
Fuel Correction Factors for ULSD	0.852	0.852	0.852	0.948	0.015	1	0.72	0.72	1	0.948	0.72

Note: 2013 Inventory, Starcrest, Table 4.6. Values except SOx based on 15 ppm vs 350 ppm S fuel. SOx correction based on 15 ppm vs 1000 ppm.

Low Load Adjustment Multipliers (2 Stroke Propulsion)		PM10 (g/kW-hr)	PM2.5 (g/kW-hr)	DPM (g/kW-hr)	NOx (g/kW-hr)	SOx (g/kW-hr)	CO (g/kW-hr)	HC (g/kW-hr)	VOC (g/kW-hr)	CO2 (g/kW-hr)	N2O (g/kW-hr)	CH4 (g/kW-hr)
Load		7.29	7.29	7.29	4.63	1	9.68	21.18	21.18	1	4.63	21.18
	2%	4.33	4.33	4.33	2.92	1	6.46	11.68	11.68	1	2.92	11.68
	3%	3.09	3.09	3.09	2.21	1	4.86	7.71	7.71	1	2.21	7.71
	4%	2.44	2.44	2.44	1.83	1	3.89	5.61	5.61	1	1.83	5.61
	5%	2.04	2.04	2.04	1.6	1	3.25	4.35	4.35	1	1.6	4.35
	6%	1.79	1.79	1.79	1.45	1	2.79	3.52	3.52	1	1.45	3.52
	7%	1.61	1.61	1.61	1.35	1	2.45	2.95	2.95	1	1.35	2.95
	8%	1.48	1.48	1.48	1.27	1	2.18	2.52	2.52	1	1.27	2.52
	9%	1.38	1.38	1.38	1.22	1	1.96	2.18	2.18	1	1.22	2.18
	10%	1.3	1.3	1.3	1.17	1	1.79	1.96	1.96	1	1.17	1.96
	11%	1.24	1.24	1.24	1.14	1	1.64	1.76	1.76	1	1.14	1.76
	12%	1.19	1.19	1.19	1.11	1	1.52	1.6	1.6	1	1.11	1.6
	13%	1.15	1.15	1.15	1.08	1	1.41	1.47	1.47	1	1.08	1.47
	14%	1.11	1.11	1.11	1.06	1	1.32	1.36	1.36	1	1.06	1.36
	15%	1.08	1.08	1.08	1.05	1	1.24	1.26	1.26	1	1.05	1.26
	16%	1.06	1.06	1.06	1.03	1	1.17	1.18	1.18	1	1.03	1.18
	17%	1.04	1.04	1.04	1.02	1	1.11	1.11	1.11	1	1.02	1.11
	18%	1.02	1.02	1.02	1.01	1	1.05	1.05	1.05	1	1.01	1.05
	19%	1	1	1	1	1	1	1	1	1	1	1
	20%	1	1	1	1	1	1	1	1	1	1	1

Note: 2014 Inventory, Starcrest, Table 3.10

Harbor speed = 5 knot inbound and 8 knot outbound per 2013 Inventory, Starcrest, Section 3.5.6

Default Assist Tug

Vessel Type	Propulsion hp	Propulsion kw	Engines	Load Factor
Assist Tug	1908	1423	2	0.31

Note: 2014 Inventory, Starcrest, Table 4.1

Load factor = 0.31 (main) and 0.43 (aux) per 2013 Inventory, Starcrest, Table 4.7

Table B1.29 Auxiliary Engine Emission Factors and Assumptions

Engine Type	Tier	Model	Fuel	PM10 (g/kW-hr)	PM2.5 (g/kW-hr)	DPM (g/kW-hr)	NOx (g/kW-hr)	SOx (g/kW-hr)	CO (g/kW-hr)	HC (g/kW-hr)	VOC (g/kW-hr)	CO2 (g/kW-hr)	N2O (g/kW-hr)	CH4 (g/kW-hr)	
Aux High Speed Diesel	Tier 0	<=1999	0.1%S	AHSD_0_1S	0.26	0.24	0.26	10.9	0.46	0.9	0.4	0.421	656	0.029	0.008
Aux Med Speed Diesel	Tier 0	<=1999	0.1%S	AMSD_0_1S	0.26	0.24	0.26	13.8	0.46	1.1	0.4	0.421	686	0.029	0.008
Aux High Speed Diesel	Tier 0	<=1999	15 ppm S	AHSD_0_ULSD	0.26	0.24	0.26	10.9	0.007	0.9	0.4	0.421	656	0.029	0.008
Aux High Speed Diesel	Tier 1	2000-2010	0.1%S	AHSD_1_1S	0.26	0.24	0.26	9.8	0.46	0.9	0.4	0.421	656	0.029	0.008
Aux Med Speed Diesel	Tier 1	2000-2010	0.1%S	AMSD_1_1S	0.26	0.24	0.26	12.2	0.46	1.1	0.4	0.421	686	0.029	0.008
Aux High Speed Diesel	Tier 1	2000-2010	15 ppm S	AHSD_1_ULSD	0.26	0.24	0.26	9.8	0.007	0.9	0.4	0.421	656	0.029	0.008
Aux High Speed Diesel	Tier 2	2011-2015	0.1%S	AHSD_2_1S	0.26	0.24	0.26	7.7	0.46	0.9	0.4	0.421	656	0.029	0.008
Aux Med Speed Diesel	Tier 2	2011-2015	0.1%S	AMSD_2_1S	0.26	0.24	0.26	10.5	0.46	1.1	0.4	0.421	686	0.029	0.008
Aux High Speed Diesel	Tier 2	2011-2015	15 ppm S	AHSD_2_ULSD	0.26	0.24	0.26	7.7	0.007	0.9	0.4	0.421	656	0.029	0.008
Aux High Speed Diesel	Tier 3	2011-2015	0.1%S	AHSD_3_1S	0.26	0.24	0.26	2	0.46	0.9	0.4	0.421	656	0.029	0.008
Aux Med Speed Diesel	Tier 3	2011-2015	0.1%S	AMSD_3_1S	0.26	0.24	0.26	2.6	0.46	1.1	0.4	0.421	686	0.029	0.008
Aux High Speed Diesel	Tier 3	2011-2015	15 ppm S	AHSD_3_ULSD	0.26	0.24	0.26	2	0.007	0.9	0.4	0.421	656	0.029	0.008
Boiler	na	all	0.1%S	Boil_1S	0.14	0.13	0.00	2	0.61	0.2	0.1	0.098	922	0.075	0.002
Boiler	na	all	15 ppm S	Boil_ULSD	0.14	0.13	0.00	2	0.009	0.2	0.1	0.098	922	0.075	0.002

Note: 2014 Inventory, Starcrest, Table 3.8 (Tier 0 - Tier 3, 0.1%S)

2014 Inventory, Starcrest, Table 3.7 (Boilers, 0.1%S)

VOC = 1.053 x HC per Conversion Factors for Hydrocarbon Emission Components, EPA-420-R-10-015, July 2010. For boilers VOC assumed as HC - CH4.

Default Hotelling Time at Berth and at Anchorage		
Vessel Type	Berth	Anchorage
Ocean Tugboat	29.1	12.8 hrs
Tanker - Chemical	33.1	32.6 hrs
Tanker - Handysize	31.9	44.7 hrs
Tanker - Panamax	40.9	53 hrs

Note: 2014 Inventory, Starcrest, Tables 3.2 and 3.3

Default Auxiliary Engine Load				
Vessel Type	Transit	Maneuvering	Berth Hotelling	Anchorage Hotelling
Ocean Tugboat	79	208	102	79 kw
Tanker - Chemical	658	890	816	658 kw
Tanker - Handysize	537	601	820	537 kw
Tanker - Panamax	561	763	623	561 kw

Note: 2014 Inventory, Starcrest, Table 3.4

Default Auxiliary Boiler Load				
Vessel Type	Transit	Maneuvering	Berth Hotelling	Anchorage Hotelling
Ocean Tugboat	0	0	0	0 kw
Tanker - Chemical	371	371	821	371 kw
Tanker - Handysize	371	371	2586	371 kw
Tanker - Panamax	371	371	3293	371 kw

Note: 2014 Inventory, Starcrest, Table 3.6. Boilers assumed not required during transit due to engine heat recovery.

Default Assist Tug				
Vessel Type	Aux Eng hp	Aux Eng kw	Engines	Load Factor
Assist Tug	182	136	2	0.43

Note: 2014 Inventory, Starcrest, Table 4.1

Load factor = 0.31 (main) and 0.43 (aux) per 2013 Inventory, Starcrest, Table 4.7

Table B1.30 Transit Distances

Route	Arrival	Departure	Zone 1 Harbor		Zone 2 Breakwater to PZ		Zone 3 PZ to 20 m		Zone 4 20 nm to 40 nm		Zone 5 40 nm to SCAB Overwater Boundary	Zone 6 SCAB to 170 nm State Overwater Boundary
			Arrive	Depart	Arrive	Depart	Arrive	Depart	Arrive	Depart		
East	0	0	3.7	7.63	7.63	25.75	25.75	0	0	0	130	
North	46%	38%	3.7	8.57	7.63	21.91	21.68	21.37	20.75	0	130	
South	36%	34%	3.7	8.47	7.36	11.11	12.55	20.18	19.92	3	127	
West	18%	28%	3.7	8.58	8.58	18.97	18.97	21.12	21.12	7	123	
Average	1	1	3.7	8.313	7.8	19.44	19.738	15.67	15.448	2.5	127.5	

Note: 2013 Inventory, Starcrest, Table 3.1

Table B1.31 Operational Emissions for Tanks and Fugitives

Process	Facility										% of 2014 Reported Total
	Throughput (bbl/yr)	HC (g/1000 bbl)	VOC (g/1000 bbl)	HC (lb/hr)	VOC (lb/hr)	HC (lb/day)	VOC (lb/day)	HC (lb/yr)	VOC (lb/yr)		
Fugitive				0.17	0.17	3.98	3.98	1,453.14	1,453.14		0.29
Tanks (Standing/Breathing)				0.41	0.41	9.74	9.74	3,553.37	3,553.37		0.70
Tanks (Withdrawal/Working)	10170144	1.63061762	1.63061762	0.00	0.00	0.10	0.10	36.56	36.56		0.01
Total				0.58	0.58	13.82	13.82	5,043.07	5,043.07		

Basis: 2014 Worksheet for 2014 SCAQMD Annual Emissions Report for Tanks and Fugitive Component Emissions

Table B1.32 Operational Emissions and Assumptions for Product Loading and Vapor Recovery Unit

Summary of Emission Factors											
Process	PM10 (lb/1000 gal)	PM2.5 (lb/1000 gal)	DPM (lb/1000 gal)	NOx (lb/1000 gal)	SOx (lb/1000 gal)	CO (lb/1000 gal)	HC (lb/1000 gal)	VOC (lb/1000 gal)	CO2 (g/MMBtu)	N2O (g/MMBtu)	CH4 (g/MMBtu)
Propane Combustion	0.28	0.28	0	12.8	4.6	3.2	0.26	0.26	61460	0.10	0.022
SCAQMD AER Reporting Tool Default Emission Factors for Propane https://www.epa.gov/sites/production/files/2015-12/documents/emission-factors_nov_2015.pdf Conversion: 90500 btu/gal AP-42 Section 1.5											
Marine Tank Loading							HC (lb/1000 bbl)	VOC (lb/1000 bbl)			
AP-42 and 99.5% control							0.378	0.378			

Emission Calculations

Process	Rating (MMBtu/hr)	PM10 (g/MMBtu)	PM2.5 (g/MMBtu)	DPM (g/MMBtu)	NOx (g/MMBtu)	SOx (g/MMBtu)	CO (g/MMBtu)	HC (g/MMBtu)	VOC (g/MMBtu)	CO2 (g/MMBtu)	N2O (g/MMBtu)	CH4 (g/MMBtu)
Propane Combustion	12	1.40	1.40	0.00	64.16	23.06	16.04	1.30	1.30	61,460	0.10	0.022
		(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
		16.84	16.84	0.00	769.87	276.67	192.47	15.64	15.64	737,520	1.20	0.26
	(1000 bbl/hr)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)	(g/1000 bbl)
Marine Tank Loading	5							171.46	171.46			
Propane Combustion		3.37	3.37	0.00	153.97	55.33	38.49	3.13	3.13	147,504	0.24	0.05
VRU (total)		3.37	3.37	0.00	153.97	55.33	38.49	174.59	174.59	147,504	0.24	0.05
		(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
VRU (total)	5	16.84	16.84	0.00	769.87	276.67	192.47	873	873	737,520	1.20	0.26
	(hr/day)	(g/day)	(g/day)	(g/day)	(g/day)	(g/day)	(g/day)	(g/day)	(g/day)	(g/day)	(g/day)	(g/day)
VRU (total)	24	404	404	0	18477	6,640	4,619	20951	20951	17,700,480	29	6
		(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)
		0.9	0.9	0.0	40.7	14.6	10.2	46.2	46.2	39,022	0.1	0.0

Emissions based on loading 20% of throughput

Facility Total (bbl/yr)	Loading (bbl/yr)	Loading (20%)	PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)
20,584,414	20%	4,116,883	31	31	-	1,397	502	349	1,585	1,585	607	1	0

Construction Workers		PM10 (g/mi)	PM2.5 (g/mi)	DPM (g/mi)	NOx (g/mi)	SOx (g/mi)	CO (g/mi)	HC (g/mi)	VOC (g/mi)	CO2 (g/mi)
	(VMT/day)	0.05	0.02	0.11	0.14	0.03	1.14	0.03	0.03	352.49
	58.8	0.01	0.00	0.01	0.01	0.15	0.00	0.00	0.00	45.69
	(day/yr)	17	0.11	0.04	0.00	0.24	2.51	0.07	0.07	0.35
Propane Truck - VMT		(g/mi)	(g/mi)	(g/mi)	(g/mi)	(g/mi)	(g/mi)	(g/mi)	(g/mi)	(g/mi)
	(VMT/day)	0.14	0.08	0.14	5.95	0.66	0.18	0.18	0.18	1618.19
	304	0.09	0.05	0.09	3.99	0.44	0.12	0.12	0.12	1084.50
	(day/yr)	51	4.79	2.73	4.79	203.37	22.56	6.15	6.15	25.09
Propane Truck - Idling		(g/veh/day)	(g/veh/day)	(g/veh/day)	(g/veh/day)	(g/veh/day)	(g/veh/day)	(g/veh/day)	(g/veh/day)	(g/veh/day)
	(hr/day)	0.06	0.05	0.06	66.84	8.31	2.06	2.06	2.06	9743.35
	2	0.00	0.00	0.00	0.29	0.04	0.01	0.01	0.01	42.96
	(day/yr)	51	0.01	0.01	0.01	15.03	1.87	0.46	0.46	0.99
Subtotal - Mobile		(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)	(lb/day)
		0.10	0.06	0.09	4.30	0.00	0.63	0.13	0.13	1173.15
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(MT/yr)
		4.91	2.79	4.80	218.64	0.00	26.94	6.68	6.68	26.43

Piping Components

(day/yr)	HC (lb/day)	VOC (lb/day)
365	0.67	0.67
	(lb/yr)	(lb/yr)
	244.73	244.73

Incremental Emissions from Hotelling During Loading

LOADING	Number of Ships	PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)
Tanker - Panamax	3	26.63	24.68	9.87	702.59	90.49	65.70	27.16	27.72	61.88	4.57	0.25
Tanker - Handysize	3	3.57	3.30	3.57	134.70	6.32	12.37	5.50	5.79	4.09	0.18	0.05
ITB	8	40.38	37.35	26.19	1431.75	108.17	131.09	50.43	52.37	73.74	4.77	0.46
Tanker - Chemical	3	68.72	30.77	2030.99	243.64	189.45	78.35	80.24	166.36	12.11	0.71	0.00
Subtotal	17	139.31	96.09	2070.62	2512.69	394.43	287.51	163.33	252.24	151.82	10.24	0.75

Note: Based on 7 hrs hotelling average incremental time for loading vs off-loading.

Table B1.33 Operational Emissions for 2011

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2011	ITB	Propulsion	Zone 1	Maneuver	33	30	33	1,550	55	140	64	67	37	2	1
2011	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2011	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2011	ITB	Auxiliary	Zone 1	Hotelling	101	93	101	3,800	178	349	155	163	115	5	1
2011	ITB	Auxiliary	Zone 1	Maneuver	8	8	8	318	15	29	13	14	10	0	0
2011	ITB	Pump	Zone 1	Hotelling	193	178	193	7,260	341	667	296	312	220	10	3
2011	ITB Tug	Propulsion	Zone 1	Maneuver	78	72	78	4,060	2	386	126	133	103	4	1
2011	ITB Tug	Auxiliary	Zone 1	Maneuver	12	11	12	358	0	42	19	20	14	1	0
2011	Tanker	Propulsion	Zone 1	Maneuver	25	23	25	1,295	22	183	109	115	15	1	1
2011	Tanker	Boiler	Zone 1	Hotelling	604	561	-	8,627	2,631	863	431	423	1,804	147	4
2011	Tanker	Boiler	Zone 1	Maneuver	4	4	-	57	17	6	3	3	12	1	0
2011	Tanker	Auxiliary	Zone 1	Hotelling	399	368	399	19,747	705	1,687	613	646	477	20	6
2011	Tanker	Auxiliary	Zone 1	Maneuver	14	13	14	686	24	58	21	22	16	1	0
2011	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2011	Tanker Tugs	Propulsion	Zone 1	Maneuver	46	42	46	2,396	1	228	75	79	61	3	1
2011	Tanker Tugs	Auxiliary	Zone 1	Maneuver	7	7	7	211	0	25	11	12	8	0	0
2011	Fugitives				-	-	-	-	-	-	2,056	2,056	-	-	-
2011	Tanks	Standing	Zone 1		-	-	-	-	-	-	5,028	5,028	-	-	-
2011	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	52	52	-	-	-
2011	Loading				-	-	-	-	-	-	-	-	-	-	-
Subtotal					1,523	1,409	915	50,366	3,993	4,661	9,072	9,143	2,894	194	18
2011	ITB	Propulsion	Zone 2	Maneuver	144	133	144	6,760	238	609	277	292	163	7	3
2011	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2011	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2011	ITB	Auxiliary	Zone 2	Hotelling	23	21	23	862	40	79	35	37	26	1	0
2011	ITB	Auxiliary	Zone 2	Maneuver	5	5	5	205	10	19	8	9	6	0	0
2011	ITB Tug	Propulsion	Zone 2	Maneuver	51	47	51	2,657	1	253	83	87	68	3	1
2011	ITB Tug	Auxiliary	Zone 2	Maneuver	8	7	8	234	0	27	12	13	9	0	0
2011	Tanker	Propulsion	Zone 2	Maneuver	43	40	43	2,728	65	232	99	105	44	2	1
2011	Tanker	Boiler	Zone 2	Hotelling	84	78	-	1,204	367	120	60	59	252	20	1
2011	Tanker	Boiler	Zone 2	Maneuver	0	0	-	6	2	1	0	0	1	0	0
2011	Tanker	Auxiliary	Zone 2	Hotelling	244	225	244	12,007	432	1,032	375	395	292	12	3
2011	Tanker	Auxiliary	Zone 2	Maneuver	13	12	13	631	22	54	19	20	15	1	0
2011	Tanker Tugs	Propulsion	Zone 2	Maneuver	33	30	33	1,712	1	163	53	56	44	2	0
2011	Tanker Tugs	Auxiliary	Zone 2	Maneuver	5	5	5	151	0	18	8	8	6	0	0
Subtotal					653	604	569	29,157	1,179	2,607	1,031	1,082	926	50	9
2011	ITB	Propulsion	Zone 3	At Sea	453	418	453	21,269	750	1,918	872	918	513	23	8
2011	ITB	Auxiliary	Zone 3	At Sea	10	9	10	368	17	34	15	16	11	0	0
2011	Tanker	Propulsion	Zone 3	At Sea	150	139	150	9,517	225	808	346	365	154	8	3
2011	Tanker	Auxiliary	Zone 3	At Sea	23	21	23	1,139	40	95	35	37	27	1	0
Subtotal					636	587	636	32,293	1,032	2,855	1,268	1,335	706	32	12
2011	ITB	Propulsion	Zone 4	At Sea	505	466	505	23,713	836	2,138	972	1,023	572	26	9
2011	ITB	Auxiliary	Zone 4	At Sea	11	10	11	401	19	37	16	17	12	1	0
2011	Tanker	Propulsion	Zone 4	At Sea	130	120	130	8,156	195	701	301	317	134	7	3
2011	Tanker	Auxiliary	Zone 4	At Sea	17	16	17	847	30	72	26	28	21	1	0
Subtotal					663	612	663	33,117	1,080	2,949	1,315	1,385	739	34	12
2011	ITB	Propulsion	Zone 5	At Sea	219	202	219	10,268	362	926	421	443	248	11	4
2011	ITB	Auxiliary	Zone 5	At Sea	3	3	3	115	5	11	5	5	4	0	0
2011	Tanker	Propulsion	Zone 5	At Sea	35	33	35	2,237	53	191	82	86	36	2	1
2011	Tanker	Auxiliary	Zone 5	At Sea	3	3	3	148	5	13	5	5	4	0	0
Subtotal					260	240	260	12,768	426	1,140	512	539	291	13	5
2011	ITB	Propulsion	Zone 6	At Sea									4,390	196	68
2011	ITB	Auxiliary	Zone 6	At Sea									62	3	1
2011	Tanker	Propulsion	Zone 6	At Sea									1,444	71	29
2011	Tanker	Auxiliary	Zone 6	At Sea									140	6	2
Subtotal (GHG Only)													6,036	276	99
Annual Total					3,736	3,452	3,043	157,702	7,710	14,212	13,199	13,484	11,591	599	154

Vessel Activity and Assumed Engine Tiers						
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2011	Vessel Type
0	61	0	0	0	61	ITB
16	12	1	0	0	29	Tanker
					12,244,870	bbt

Assumed Control for Tugs in 2023+ (Tier 4 Propulsion/Tier 3 Auxiliary)

2011	ITB Tug	Propulsion	Zone 1	Maneuver	11	11	11	487	2	1,352	51	54	80	4	0
2011	ITB Tug	Auxiliary	Zone 1	Maneuver	9	9	9	72	0	32	14	15	11	0	0
2011	ITB Tug	Propulsion	Zone 2	Maneuver	7	7	7	298	1	827	31	33	49	2	0
2011	ITB Tug	Auxiliary	Zone 2	Maneuver	6	5	6	44	0	20	9	9	7	0	0
2011	Tanker Tug	Propulsion	Zone 1	Maneuver	12	12	12	518	2	1,439	55	58	85	4	1
2011	Tanker Tug	Auxiliary	Zone 1	Maneuver	10	9	10	76	0	34	15	16	11	1	0
2011	Tanker Tug	Propulsion	Zone 2	Maneuver	8	8	8	382	1	1,062	40	42	63	3	0
2011	Tanker Tug	Auxiliary	Zone 2	Maneuver	7	7	7	56	0	25	11	12	8	0	0

Assumed Emissions for 20% Loading in Future Years

2011	Loading	VRU	Zone 1		18	18	-	831	299	208	943	943	361	1	0
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VSRP Mitigation (95% Overall)

2011	Tanker	Propulsion	Zone 3	At Sea	148	137	148	9,393	222	797	342	360	152	7	3
2011	Tanker	Auxiliary	Zone 3	At Sea	23	21	23	1,143	40	96	35	37	27	1	0
2011	Tanker	Propulsion	Zone 4	At Sea	126	117	126	7,926	190	681	292	307	130	6	3
2011	Tanker	Auxiliary	Zone 4	At Sea	17	16	17	854	31	73	27	28	21	1	0

VSRP Compliance	Total Trips	Unmitigated Compliance		Mitigated Compliance						
		<20 nm	<40 nm trips	<20 nm	<40 nm trips	<20 nm	<40 nm trips			
2011	ITB	122	122	1	122	1	122	1		
2011	Tanker	58	50	86%	48	83%	55	95%	55	95%
2011	Total	180	172	96%	170	94%	177	98%	177	98%

Table B1.34 Operational Emissions for 2012

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2012	ITB	Propulsion	Zone 1	Maneuver	29	27	29	1,350	48	122	55	58	33	1	1
2012	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2012	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2012	ITB	Auxiliary	Zone 1	Hotelling	95	88	95	3,583	168	329	146	154	109	5	1
2012	ITB	Auxiliary	Zone 1	Maneuver	8	7	8	295	14	27	12	13	9	0	0
2012	ITB	Pump	Zone 1	Hotelling	182	168	182	6,846	321	629	279	294	208	9	3
2012	ITB Tug	Propulsion	Zone 1	Maneuver	72	67	72	3,768	2	358	117	124	96	4	1
2012	ITB Tug	Auxiliary	Zone 1	Maneuver	11	10	11	333	0	39	17	18	13	1	0
2012	Tanker	Propulsion	Zone 1	Maneuver	18	16	18	922	15	132	80	84	10	1	1
2012	Tanker	Boiler	Zone 1	Hotelling	461	428	-	6,579	2,007	658	329	322	1,376	112	3
2012	Tanker	Boiler	Zone 1	Maneuver	3	3	-	41	13	4	2	2	9	1	0
2012	Tanker	Auxiliary	Zone 1	Hotelling	318	294	318	15,730	563	1,346	489	515	381	16	4
2012	Tanker	Auxiliary	Zone 1	Maneuver	11	10	11	529	19	45	16	17	13	1	0
2012	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2012	Tanker Tugs	Propulsion	Zone 1	Maneuver	28	25	28	1,440	1	137	45	47	37	2	0
2012	Tanker Tugs	Auxiliary	Zone 1	Maneuver	4	4	4	127	0	15	7	7	5	0	0
2012	Fugitives				-	-	-	-	-	-	1,908	1,908	-	-	-
2012	Tanks	Standing	Zone 1		-	-	-	-	-	-	4,666	4,666	-	-	-
2012	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	48	48	-	-	-
2012	Loading				-	-	-	-	-	-	-	-	-	-	-
Subtotal					1,239	1,146	775	41,542	3,170	3,840	1,596	1,656	2,297	152	14
2012	ITB	Propulsion	Zone 2	Maneuver	127	117	127	5,966	210	538	245	257	144	6	2
2012	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2012	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2012	ITB	Auxiliary	Zone 2	Hotelling	16	15	16	622	29	57	25	27	19	1	0
2012	ITB	Auxiliary	Zone 2	Maneuver	5	5	5	187	9	17	8	8	6	0	0
2012	ITB Tug	Propulsion	Zone 2	Maneuver	47	44	47	2,471	1	235	77	81	63	3	1
2012	ITB Tug	Auxiliary	Zone 2	Maneuver	7	7	7	218	0	25	11	12	8	0	0
2012	Tanker	Propulsion	Zone 2	Maneuver	30	27	30	1,878	45	160	69	72	31	2	1
2012	Tanker	Boiler	Zone 2	Hotelling	87	81	-	1,246	380	125	62	61	261	21	1
2012	Tanker	Boiler	Zone 2	Maneuver	0	0	-	4	1	0	0	0	1	0	0
2012	Tanker	Auxiliary	Zone 2	Hotelling	267	246	267	12,970	472	1,128	410	432	319	13	4
2012	Tanker	Auxiliary	Zone 2	Maneuver	9	9	9	462	16	39	14	15	11	0	0
2012	Tanker Tugs	Propulsion	Zone 2	Maneuver	19	18	19	1,012	1	96	32	33	26	1	0
2012	Tanker Tugs	Auxiliary	Zone 2	Maneuver	3	3	3	89	0	10	5	5	3	0	0
Subtotal					619	572	531	27,126	1,165	2,432	958	1,004	891	49	9
2012	ITB	Propulsion	Zone 3	At Sea	402	371	402	18,863	665	1,701	773	814	455	20	7
2012	ITB	Auxiliary	Zone 3	At Sea	9	8	9	339	16	31	14	15	10	0	0
2012	Tanker	Propulsion	Zone 3	At Sea	96	88	96	6,049	144	516	221	233	98	5	2
2012	Tanker	Auxiliary	Zone 3	At Sea	16	15	16	802	28	67	25	26	19	1	0
Subtotal					523	482	523	26,052	853	2,315	1,032	1,087	583	26	9
2012	ITB	Propulsion	Zone 4	At Sea	441	407	441	20,676	729	1,864	847	892	499	22	8
2012	ITB	Auxiliary	Zone 4	At Sea	10	9	10	377	18	35	15	16	11	1	0
2012	Tanker	Propulsion	Zone 4	At Sea	95	88	95	5,981	143	513	220	232	98	5	2
2012	Tanker	Auxiliary	Zone 4	At Sea	13	12	13	662	24	57	21	22	16	1	0
Subtotal					559	516	559	27,697	913	2,469	1,103	1,162	624	28	10
2012	ITB	Propulsion	Zone 5	At Sea	190	176	190	8,934	315	806	366	386	216	10	3
2012	ITB	Auxiliary	Zone 5	At Sea	3	3	3	104	5	10	4	4	3	0	0
2012	Tanker	Propulsion	Zone 5	At Sea	25	23	25	1,577	37	135	58	61	26	1	1
2012	Tanker	Auxiliary	Zone 5	At Sea	2	2	2	105	4	9	3	3	3	0	0
Subtotal					220	203	220	10,719	361	958	431	454	247	11	4
2012	ITB	Propulsion	Zone 6	At Sea									3,898	174	60
2012	ITB	Auxiliary	Zone 6	At Sea									57	3	1
2012	Tanker	Propulsion	Zone 6	At Sea									1,020	50	21
2012	Tanker	Auxiliary	Zone 6	At Sea									105	4	1
Subtotal (GHG Only)													5,080	231	83
Annual Total					3,160	2,920	2,609	133,137	6,462	12,014	5,121	5,363	9,722	498	129

Vessel Activity and Assumed Engine Tiers						
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2012	Vessel Type
0	56	0	0	0	56	ITB
10	11	0	0	0	21	Tanker
11,539,497						bbl

Assumed Control for Tugs in 2023+ (Tier 4 Propulsion/Tier 3 Auxiliary)

2012	ITB Tug	Propulsion	Zone 1	Maneuver	10	10	10	439	1	1,220	46	49	72	3	0
2012	ITB Tug	Auxiliary	Zone 1	Maneuver	8	8	8	65	0	29	13	14	10	0	0
2012	ITB Tug	Propulsion	Zone 2	Maneuver	6	6	6	270	1	751	29	30	44	2	0
2012	ITB Tug	Auxiliary	Zone 2	Maneuver	5	5	5	40	0	18	8	8	6	0	0
2012	Tanker Tug	Propulsion	Zone 1	Maneuver	8	8	8	371	1	1,031	39	41	61	3	0
2012	Tanker Tug	Auxiliary	Zone 1	Maneuver	7	7	7	55	0	25	11	12	8	0	0
2012	Tanker Tug	Propulsion	Zone 2	Maneuver	6	6	6	272	1	755	29	30	45	2	0
2012	Tanker Tug	Auxiliary	Zone 2	Maneuver	5	5	5	40	0	18	8	8	6	0	0

Assumed Emissions for 20% Loading in Future Years

2012	Loading	VRU	Zone 1		17	17	-	783	282	196	888	888	340	1	0
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VSRP Mitigation (95% Overall)

2012	Tanker	Propulsion	Zone 3	At Sea	95	87	95	5,975	142	509	218	230	97	5	2
2012	Tanker	Auxiliary	Zone 3	At Sea	16	15	16	804	28	68	25	26	19	1	0
2012	Tanker	Propulsion	Zone 4	At Sea	94	87	94	5,911	141	507	217	229	97	5	2
2012	Tanker	Auxiliary	Zone 4	At Sea	13	12	13	665	24	57	21	22	16	1	0

VSRP Compliance	Total Trips	Unmitigated Compliance <20 nm				Mitigated Compliance <20 nm				
		<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	
2012	ITB	112	112	1	112	1	112	1	112	1
2012	Tanker	42	36	86%	37	88%	40	95%	40	95%
2012	Total	154	148	96%	149	97%	152	99%	152	99%

Table B1.35 Operational Emissions for 2013

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2013	ITB	Propulsion	Zone 1	Maneuver	33	30	33	1,550	55	140	64	67	37	2	1
2013	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2013	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2013	ITB	Auxiliary	Zone 1	Hotelling	106	98	106	3,988	187	366	163	171	121	5	1
2013	ITB	Auxiliary	Zone 1	Maneuver	9	8	9	335	16	31	14	14	10	0	0
2013	ITB	Pump	Zone 1	Hotelling	202	187	202	7,620	358	700	311	328	231	10	3
2013	ITB Tug	Propulsion	Zone 1	Maneuver	81	75	81	4,218	2	401	131	138	107	5	1
2013	ITB Tug	Auxiliary	Zone 1	Maneuver	13	12	13	372	0	44	19	20	14	1	0
2013	Tanker	Propulsion	Zone 1	Maneuver	14	13	14	730	13	107	63	66	9	1	1
2013	Tanker	Boiler	Zone 1	Hotelling	313	290	-	4,469	1,363	447	223	219	934	76	2
2013	Tanker	Boiler	Zone 1	Maneuver	2	2	-	31	10	3	2	2	7	1	0
2013	Tanker	Auxiliary	Zone 1	Hotelling	264	244	264	12,076	468	1,118	407	428	316	13	4
2013	Tanker	Auxiliary	Zone 1	Maneuver	9	9	9	427	16	39	14	15	11	0	0
2013	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2013	Tanker Tugs	Propulsion	Zone 1	Maneuver	16	15	16	832	0	79	26	27	21	1	0
2013	Tanker Tugs	Auxiliary	Zone 1	Maneuver	2	2	2	73	0	9	4	4	3	0	0
2013	Tanks	Fugitives	-	-	-	-	-	-	-	-	1,546	1,546	-	-	-
2013	Tanks	Standing	Zone 1	-	-	-	-	-	-	-	3,781	3,781	-	-	-
2013	Tanks	Withdrawal	Zone 1	-	-	-	-	-	-	-	39	39	-	-	-
2013	Loading	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal					1,065	985	750	36,721	2,488	3,483	1,440	1,500	1,823	115	13
2013	ITB	Propulsion	Zone 2	Maneuver	144	133	144	6,762	238	610	277	292	163	7	3
2013	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2013	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2013	ITB	Auxiliary	Zone 2	Hotelling	31	29	31	1,180	55	108	48	51	36	2	0
2013	ITB	Auxiliary	Zone 2	Maneuver	6	5	6	208	10	19	9	9	6	0	0
2013	ITB Tug	Propulsion	Zone 2	Maneuver	53	49	53	2,752	2	262	86	90	70	3	1
2013	ITB Tug	Auxiliary	Zone 2	Maneuver	8	8	8	243	0	28	13	13	9	0	0
2013	Tanker	Propulsion	Zone 2	Maneuver	26	24	26	1,548	38	138	59	62	26	1	1
2013	Tanker	Boiler	Zone 2	Hotelling	59	55	-	844	257	84	42	41	176	14	0
2013	Tanker	Boiler	Zone 2	Maneuver	0	0	-	3	1	0	0	0	1	0	0
2013	Tanker	Auxiliary	Zone 2	Hotelling	182	168	182	8,347	321	768	279	294	217	9	3
2013	Tanker	Auxiliary	Zone 2	Maneuver	8	7	8	348	13	32	12	12	9	0	0
2013	Tanker Tugs	Propulsion	Zone 2	Maneuver	12	11	12	646	0	61	20	21	16	1	0
2013	Tanker Tugs	Auxiliary	Zone 2	Maneuver	2	2	2	57	0	7	3	3	2	0	0
Subtotal					530	490	471	22,937	937	2,118	847	889	733	39	8
2013	ITB	Propulsion	Zone 3	At Sea	415	383	415	19,471	686	1,756	798	840	470	21	7
2013	ITB	Auxiliary	Zone 3	At Sea	10	9	10	377	18	35	15	16	11	1	0
2013	Tanker	Propulsion	Zone 3	At Sea	83	76	83	4,996	124	445	191	201	85	4	2
2013	Tanker	Auxiliary	Zone 3	At Sea	12	11	12	552	21	51	18	19	14	1	0
Subtotal					520	480	520	25,396	849	2,286	1,023	1,077	581	26	9
2013	ITB	Propulsion	Zone 4	At Sea	490	452	490	22,976	810	2,072	942	992	554	25	9
2013	ITB	Auxiliary	Zone 4	At Sea	11	10	11	403	19	37	16	17	12	1	0
2013	Tanker	Propulsion	Zone 4	At Sea	91	84	91	5,475	136	487	209	220	93	5	2
2013	Tanker	Auxiliary	Zone 4	At Sea	12	11	12	563	22	52	19	20	15	1	0
Subtotal					603	557	603	29,417	986	2,648	1,186	1,249	674	31	11
2013	ITB	Propulsion	Zone 5	At Sea	208	192	208	9,774	344	881	401	422	236	11	4
2013	ITB	Auxiliary	Zone 5	At Sea	3	3	3	112	5	10	5	5	3	0	0
2013	Tanker	Propulsion	Zone 5	At Sea	18	16	18	1,062	26	95	41	43	18	1	0
2013	Tanker	Auxiliary	Zone 5	At Sea	1	1	1	68	3	6	2	2	2	0	0
Subtotal					230	213	230	11,015	379	992	448	472	259	12	4
2013	ITB	Propulsion	Zone 6	At Sea	-	-	-	-	-	-	-	-	4,291	192	66
2013	ITB	Auxiliary	Zone 6	At Sea	-	-	-	-	-	-	-	-	62	3	1
2013	Tanker	Propulsion	Zone 6	At Sea	-	-	-	-	-	-	-	-	861	42	18
2013	Tanker	Auxiliary	Zone 6	At Sea	-	-	-	-	-	-	-	-	86	4	1
Subtotal (GHG Only)					-	-	-	-	-	-	-	-	86	4	1
Annual Total					2,948	2,723	2,574	125,487	5,639	11,527	4,944	5,186	9,370	462	130

Vessel Activity and Assumed Engine Tiers						
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2013	Vessel Type
0	62	0	0	0	62	ITB
0	14	2	0	0	16	Tanker
					11,716,522	bbl

Assumed Control for Tugs in 2023+ (Tier 4 Propulsion/Tier 3 Auxiliary)

2013	ITB Tug	Propulsion	Zone 1	Maneuver	11	11	11	502	2	1,396	53	56	83	4	1
2013	ITB Tug	Auxiliary	Zone 1	Maneuver	10	9	10	74	0	33	15	16	11	0	0
2013	ITB Tug	Propulsion	Zone 2	Maneuver	7	7	7	322	1	894	34	36	53	3	0
2013	ITB Tug	Auxiliary	Zone 2	Maneuver	6	6	6	47	0	21	9	10	7	0	0
2013	Tanker Tug	Propulsion	Zone 1	Maneuver	6	6	6	284	1	788	30	32	47	2	0
2013	Tanker Tug	Auxiliary	Zone 1	Maneuver	5	5	5	42	0	19	8	9	6	0	0
2013	Tanker Tug	Propulsion	Zone 2	Maneuver	5	5	5	207	1	575	22	23	34	2	0
2013	Tanker Tug	Auxiliary	Zone 2	Maneuver	4	4	4	30	0	14	6	6	5	0	0

Assumed Emissions for 20% Loading in Future Years

2013	Loading	VRU	Zone 1	-	17	17	-	795	286	199	902	902	346	1	0
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VSRP Mitigation (95% Overall)

2013	Tanker	Propulsion	Zone 3	At Sea	82	76	82	4,983	124	444	190	200	85	4	2
2013	Tanker	Auxiliary	Zone 3	At Sea	12	11	12	552	21	51	18	19	14	1	0
2013	Tanker	Propulsion	Zone 4	At Sea	90	83	90	5,441	135	484	208	219	92	5	2
2013	Tanker	Auxiliary	Zone 4	At Sea	12	11	12	564	22	52	19	20	15	1	0

VSRP Compliance	Total Trips	Unmitigated Compliance <20 nm				Mitigated Compliance <20 nm									
		<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips	<40 nm trips						
2013	ITB	124	124	1	124	1	124	1	124	1	124	1	124	1	124
2013	Tanker	32	29	91%	28	88%	30	94%	30	94%	30	94%	30	94%	30
2013	Total	156	153	98%	152	97%	154	99%	154	99%	154	99%	154	99%	154

Table B1.36 Operational Emissions for 2014

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2014	ITB	Propulsion	Zone 1	Maneuver	27	25	27	1,287	45	116	53	56	31	1	0
2014	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2014	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2014	ITB	Auxiliary	Zone 1	Hotelling	93	86	93	3,512	165	323	143	151	107	5	1
2014	ITB	Auxiliary	Zone 1	Maneuver	7	7	7	276	13	25	11	12	8	0	0
2014	ITB	Pump	Zone 1	Hotelling	178	164	178	6,710	315	616	274	288	204	9	2
2014	ITB Tug	Propulsion	Zone 1	Maneuver	48	44	48	2,497	1	237	78	82	64	3	1
2014	ITB Tug	Auxiliary	Zone 1	Maneuver	7	7	7	220	0	26	11	12	9	0	0
2014	Tanker	Propulsion	Zone 1	Maneuver	11	10	11	562	10	81	47	49	7	0	0
2014	Tanker	Boiler	Zone 1	Hotelling	430	399	-	6,145	1,874	614	307	301	1,285	105	3
2014	Tanker	Boiler	Zone 1	Maneuver	2	1	-	22	7	2	1	1	5	0	0
2014	Tanker	Auxiliary	Zone 1	Hotelling	205	189	205	9,336	363	867	315	332	245	10	3
2014	Tanker	Auxiliary	Zone 1	Maneuver	6	5	6	257	10	24	9	9	7	0	0
2014	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2014	Tanker Tugs	Propulsion	Zone 1	Maneuver	29	27	29	1,507	1	143	47	49	38	2	0
2014	Tanker Tugs	Auxiliary	Zone 1	Maneuver	4	4	4	133	0	16	7	7	5	0	0
2014	Tanks	Fugitives	-	-	-	-	-	-	-	-	1,453	1,453	-	-	-
2014	Tanks	Standing	Zone 1	-	-	-	-	-	-	-	3,553	3,553	-	-	-
2014	Tanks	Withdrawal	Zone 1	-	-	-	-	-	-	-	37	37	-	-	-
2014	Loading	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal					1,048	970	616	32,465	2,804	3,090	6,346	6,393	2,014	136	12
2014	ITB	Propulsion	Zone 2	Maneuver	118	109	118	5,522	195	498	226	238	133	6	2
2014	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2014	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2014	ITB	Auxiliary	Zone 2	Hotelling	253	234	253	9,552	448	877	390	411	290	13	4
2014	ITB	Auxiliary	Zone 2	Maneuver	5	4	5	172	8	16	7	7	5	0	0
2014	ITB Tug	Propulsion	Zone 2	Maneuver	26	24	26	1,360	1	129	42	45	35	1	0
2014	ITB Tug	Auxiliary	Zone 2	Maneuver	4	4	4	120	0	14	6	7	5	0	0
2014	Tanker	Propulsion	Zone 2	Maneuver	23	21	23	1,368	34	121	52	55	23	1	0
2014	Tanker	Boiler	Zone 2	Hotelling	19	18	-	278	85	28	14	14	58	5	0
2014	Tanker	Boiler	Zone 2	Maneuver	0	0	-	3	1	0	0	0	1	0	0
2014	Tanker	Auxiliary	Zone 2	Hotelling	55	51	55	2,573	98	234	85	90	66	3	1
2014	Tanker	Auxiliary	Zone 2	Maneuver	6	5	6	266	10	24	9	9	7	0	0
2014	Tanker Tugs	Propulsion	Zone 2	Maneuver	22	20	22	1,129	1	107	35	37	29	1	0
2014	Tanker Tugs	Auxiliary	Zone 2	Maneuver	3	3	3	100	0	12	5	5	4	0	0
Subtotal					534	493	515	22,443	881	2,062	872	918	656	31	8
2014	ITB	Propulsion	Zone 3	At Sea	370	342	370	17,376	612	1,567	712	750	419	19	6
2014	ITB	Auxiliary	Zone 3	At Sea	8	8	8	314	15	29	13	14	10	0	0
2014	Tanker	Propulsion	Zone 3	At Sea	75	70	75	4,579	113	406	174	183	78	4	2
2014	Tanker	Auxiliary	Zone 3	At Sea	9	8	9	414	16	38	14	15	11	0	0
Subtotal					463	428	463	22,684	756	2,040	913	961	517	23	8
2014	ITB	Propulsion	Zone 4	At Sea	410	379	410	19,246	678	1,735	789	831	464	21	7
2014	ITB	Auxiliary	Zone 4	At Sea	9	9	9	350	16	32	14	15	11	0	0
2014	Tanker	Propulsion	Zone 4	At Sea	86	79	86	5,198	128	461	198	208	88	4	2
2014	Tanker	Auxiliary	Zone 4	At Sea	10	9	10	454	17	42	15	16	12	0	0
Subtotal					515	475	515	25,247	841	2,270	1,016	1,070	575	26	9
2014	ITB	Propulsion	Zone 5	At Sea	181	167	181	8,509	300	767	349	367	205	9	3
2014	ITB	Auxiliary	Zone 5	At Sea	3	2	3	98	5	9	4	4	3	0	0
2014	Tanker	Propulsion	Zone 5	At Sea	17	15	17	1,007	25	89	38	40	17	1	0
2014	Tanker	Auxiliary	Zone 5	At Sea	1	1	1	47	2	4	2	2	1	0	0
Subtotal					201	186	201	9,661	331	869	392	413	226	10	4
2014	ITB	Propulsion	Zone 6	At Sea	-	-	-	-	-	-	-	-	3,645	163	56
2014	ITB	Auxiliary	Zone 6	At Sea	-	-	-	-	-	-	-	-	53	2	1
2014	Tanker	Propulsion	Zone 6	At Sea	-	-	-	-	-	-	-	-	763	38	16
2014	Tanker	Auxiliary	Zone 6	At Sea	-	-	-	-	-	-	-	-	60	3	1
Subtotal (GHG Only)					-	-	-	-	-	-	-	-	4,520	205	73
Annual Total					2,762	2,552	2,310	112,500	5,613	10,332	9,540	9,754	8,508	432	114

Vessel Activity and Assumed Engine Tiers						
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2014	Vessel Type
0	52	0	0	0	52	ITB
0	11	2	0	0	13	Tanker
10,170,144						bbl

Assumed Control for Tugs in 2023+ (Tier 4 Propulsion/Tier 3 Auxiliary)

2014	ITB Tug	Propulsion	Zone 1	Maneuver	9	9	9	389	1	1,079	41	43	64	3	0
2014	ITB Tug	Auxiliary	Zone 1	Maneuver	7	7	7	57	0	26	11	12	9	0	0
2014	ITB Tug	Propulsion	Zone 2	Maneuver	5	5	5	212	1	588	22	24	35	2	0
2014	ITB Tug	Auxiliary	Zone 2	Maneuver	4	4	4	31	0	14	6	7	5	0	0
2014	Tanker Tug	Propulsion	Zone 1	Maneuver	5	5	5	235	1	652	25	26	39	2	0
2014	Tanker Tug	Auxiliary	Zone 1	Maneuver	4	4	4	35	0	16	7	7	5	0	0
2014	Tanker Tug	Propulsion	Zone 2	Maneuver	4	4	4	176	1	488	19	20	29	1	0
2014	Tanker Tug	Auxiliary	Zone 2	Maneuver	3	3	3	26	0	12	5	5	4	0	0

Assumed Emissions for 20% Loading in Future Years

2014	Loading	VRU	Zone 1	-	15	15	-	690	248	173	783	783	300	0	0
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VSRP Mitigation (95% Overall)

2014	Tanker	Propulsion	Zone 3	At Sea	75	69	75	4,539	112	403	173	182	77	4	2
2014	Tanker	Auxiliary	Zone 3	At Sea	9	8	9	416	16	38	14	15	11	0	0
2014	Tanker	Propulsion	Zone 4	At Sea	84	78	84	5,124	127	455	195	205	87	4	2
2014	Tanker	Auxiliary	Zone 4	At Sea	10	9	10	456	17	42	15	16	12	1	0

VSRP Compliance

	Total Trips	Unmitigated Compliance <20 nm			Mitigated Compliance <20 nm					
		<20 nm	<40 nm trips	<40 nm trips	<20 nm	<40 nm trips	<40 nm trips			
2014	ITB	104	104	1	104	1	104	1	104	1
2014	Tanker	26	22	85%	22	85%	25	96%	25	96%
2014	Total	130	126	97%	126	97%	129	99%	129	99%

Table B1.37 Operational Emissions for 2015

Year	Source	Zone	Activity	Annual Emissions												
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)		
2015	ITB	Propulsion	Zone 1	Maneuver	38	35	38	1,773	63	160	73	77	43	2	1	
2015	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-	
2015	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-	
2015	ITB	Auxiliary	Zone 1	Maneuver	119	110	119	4,489	211	412	183	193	136	6	2	
2015	ITB	Auxiliary	Zone 1	Maneuver	10	9	10	378	18	35	15	16	11	1	0	
2015	ITB	Pump	Zone 1	Hotelling	228	210	228	8,577	403	788	350	369	260	12	3	
2015	ITB Tug	Propulsion	Zone 1	Maneuver	81	75	81	4,218	2	401	131	138	107	5	1	
2015	ITB Tug	Auxiliary	Zone 1	Maneuver	13	12	13	372	0	44	19	20	14	1	0	
2015	Tanker	Propulsion	Zone 1	Maneuver	48	44	48	2,398	43	354	210	221	29	2	2	
2015	Tanker	Boiler	Zone 1	Hotelling	959	891	-	13,704	4,180	1,370	685	671	2,866	233	6	
2015	Tanker	Boiler	Zone 1	Maneuver	7	7	-	100	31	10	5	5	21	2	0	
2015	Tanker	Auxiliary	Zone 1	Hotelling	947	874	947	43,080	1,675	4,005	1,456	1,534	1,133	48	13	
2015	Tanker	Auxiliary	Zone 1	Maneuver	29	27	29	1,335	52	124	45	47	35	1	0	
2015	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-	
2015	Tanker Tugs	Propulsion	Zone 1	Maneuver	98	90	98	5,095	3	485	159	167	130	5	1	
2015	Tanker Tugs	Auxiliary	Zone 1	Maneuver	15	14	15	450	0	53	23	25	17	1	0	
2015	Fugitives	-	-	-	-	-	-	-	-	-	1,349	1,349	-	-	-	
2015	Tanks	Standing	Zone 1	-	-	-	-	-	-	-	3,299	3,299	-	-	-	
2015	Tanks	Withdrawal	Zone 1	-	-	-	-	-	-	-	34	34	-	-	-	
2015	Loading	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Subtotal					2,591	2,397	1,624	85,969	6,679	8,240	8,038	8,165	4,804	318	30	
2015	ITB	Propulsion	Zone 2	Maneuver	159	147	159	7,456	263	672	306	322	180	8	3	
2015	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-	
2015	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-	
2015	ITB	Auxiliary	Zone 2	Hotelling	3	3	3	131	6	12	5	6	4	0	0	
2015	ITB	Auxiliary	Zone 2	Maneuver	6	6	6	229	11	21	9	10	7	0	0	
2015	ITB Tug	Propulsion	Zone 2	Maneuver	44	40	44	2,283	1	217	71	75	58	2	1	
2015	ITB Tug	Auxiliary	Zone 2	Maneuver	7	6	7	202	0	24	10	11	8	0	0	
2015	Tanker	Propulsion	Zone 2	Maneuver	80	74	80	4,824	120	429	184	194	82	4	2	
2015	Tanker	Boiler	Zone 2	Hotelling	251	233	-	3,591	1,095	359	180	176	751	61	2	
2015	Tanker	Boiler	Zone 2	Maneuver	1	1	-	13	4	1	1	1	3	0	0	
2015	Tanker	Auxiliary	Zone 2	Hotelling	786	726	786	35,892	1,391	3,326	1,209	1,274	941	40	11	
2015	Tanker	Auxiliary	Zone 2	Maneuver	23	21	23	1,054	41	98	36	37	28	1	0	
2015	Tanker Tugs	Propulsion	Zone 2	Maneuver	78	72	78	4,058	2	386	126	133	103	4	1	
2015	Tanker Tugs	Auxiliary	Zone 2	Maneuver	12	11	12	358	0	42	19	20	14	1	0	
Subtotal					1,450	1,340	1,198	60,091	2,935	5,587	2,156	2,257	2,178	123	20	
2015	ITB	Propulsion	Zone 3	At Sea	514	475	514	24,140	851	2,177	989	1,042	582	26	9	
2015	ITB	Auxiliary	Zone 3	At Sea	11	10	11	420	20	39	17	18	13	1	0	
2015	Tanker	Propulsion	Zone 3	At Sea	233	215	233	14,070	349	1,252	537	565	239	12	5	
2015	Tanker	Auxiliary	Zone 3	At Sea	33	30	33	1,487	58	138	50	53	39	2	0	
Subtotal					791	730	791	40,117	1,277	3,605	1,593	1,678	873	40	14	
2015	ITB	Propulsion	Zone 4	At Sea	565	521	565	26,496	934	2,389	1,086	1,143	639	29	10	
2015	ITB	Auxiliary	Zone 4	At Sea	12	11	12	468	22	43	19	20	14	1	0	
2015	Tanker	Propulsion	Zone 4	At Sea	303	280	303	18,336	455	1,634	700	737	312	15	6	
2015	Tanker	Auxiliary	Zone 4	At Sea	38	35	38	1,709	66	159	58	61	45	2	1	
Subtotal					918	847	918	47,009	1,477	4,225	1,863	1,962	1,010	46	17	
2015	ITB	Propulsion	Zone 5	At Sea	241	222	241	11,294	398	1,018	463	487	273	12	4	
2015	ITB	Auxiliary	Zone 5	At Sea	3	3	3	129	6	12	5	6	4	0	0	
2015	Tanker	Propulsion	Zone 5	At Sea	48	44	48	2,884	71	256	110	116	49	2	1	
2015	Tanker	Auxiliary	Zone 5	At Sea	4	3	4	173	7	16	6	6	5	0	0	
Subtotal					295	273	295	14,480	482	1,302	584	615	330	15	5	
2015	ITB	Propulsion	Zone 6	At Sea	-	-	-	-	-	-	-	4,977	222	77	-	
2015	ITB	Auxiliary	Zone 6	At Sea	-	-	-	-	-	-	-	71	3	1	-	
2015	Tanker	Propulsion	Zone 6	At Sea	-	-	-	-	-	-	-	2,645	130	54	-	
2015	Tanker	Auxiliary	Zone 6	At Sea	-	-	-	-	-	-	-	249	11	3	-	
Subtotal (GHG Only)					-	-	-	-	-	-	-	7,943	366	134	-	
Annual Total					6,045	5,587	4,826	247,666	12,850	22,959	14,234	14,676	17,138	908	221	-

Vessel Activity and Assumed Engine Tiers						
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2015	Vessel Type
0	70	0	0	0	70	ITB
0	39	9	0	0	48	Tanker
					20,584,414	bbl

Assumed Control for Tugs in 2023+ (Tier 4 Propulsion/Tier 3 Auxiliary)

2015	ITB Tug	Propulsion	Zone 1	Maneuver	11	11	11	504	2	1,400	53	56	83	4	1
2015	ITB Tug	Auxiliary	Zone 1	Maneuver	10	9	10	74	0	33	15	16	11	0	0
2015	ITB Tug	Propulsion	Zone 2	Maneuver	5	5	5	246	1	684	26	27	40	2	0
2015	ITB Tug	Auxiliary	Zone 2	Maneuver	5	4	5	36	0	16	7	8	5	0	0
2015	Tanker Tug	Propulsion	Zone 1	Maneuver	21	21	21	945	3	2,626	100	105	155	7	1
2015	Tanker Tug	Auxiliary	Zone 1	Maneuver	18	17	18	139	0	63	28	29	21	1	0
2015	Tanker Tug	Propulsion	Zone 2	Maneuver	16	16	16	741	2	2,058	78	82	122	6	1
2015	Tanker Tug	Auxiliary	Zone 2	Maneuver	14	13	14	109	0	49	22	23	16	1	0

Assumed Emissions for 20% Loading in Future Years

2015	Loading	VRU	Zone 1	-	31	31	-	1,397	502	349	1,585	1,585	607	1	0
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VSRP Mitigation (95% Overall)

2015	Tanker	Propulsion	Zone 3	At Sea	227	209	227	13,731	340	1,222	524	552	233	11	5
2015	Tanker	Auxiliary	Zone 3	At Sea	33	30	33	1,500	58	139	51	53	39	2	0
2015	Tanker	Propulsion	Zone 4	At Sea	295	272	295	17,808	442	1,587	680	716	303	15	6
2015	Tanker	Auxiliary	Zone 4	At Sea	38	35	38	1,728	67	160	58	61	45	2	1

VSRP Compliance	Total Trips	Unmitigated Compliance				Mitigated Compliance				
		<20 nm	140	<40 nm trips	140	<20 nm	140	<40 nm trips	140	
2015	ITB	140	140	1	140	1	140	1	140	1
2015	Tanker	94	71	76%	68	72%	90	96%	89	95%
2015	Total	234	211	90%	208	89%	230	98%	229	98%

Table B1.38 Operational Emissions for 2011-2015 Baseline

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2011 - 2015	ITB	Propulsion	Zone 1	Maneuver	32	30	32	1,502	53	135	62	65	36	2	1
2011 - 2015	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2011 - 2015	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2011 - 2015	ITB	Auxiliary	Zone 1	Hotelling	103	95	103	3,874	182	356	158	167	118	5	1
2011 - 2015	ITB	Auxiliary	Zone 1	Maneuver	8	8	8	320	15	29	13	14	10	0	0
2011 - 2015	ITB	Pump	Zone 1	Hotelling	196	181	196	7,403	347	680	302	318	225	10	3
2011 - 2015	ITB Tug	Propulsion	Zone 1	Maneuver	72	66	72	3,752	2	357	117	123	96	4	1
2011 - 2015	ITB Tug	Auxiliary	Zone 1	Maneuver	11	10	11	331	0	39	17	18	13	1	0
2011 - 2015	Tanker	Propulsion	Zone 1	Maneuver	23	21	23	1,181	21	171	102	107	14	1	1
2011 - 2015	Tanker	Boiler	Zone 1	Hotelling	553	514	-	7,905	2,411	790	395	387	1,653	134	4
2011 - 2015	Tanker	Boiler	Zone 1	Maneuver	4	3	-	50	15	5	3	2	11	1	0
2011 - 2015	Tanker	Auxiliary	Zone 1	Hotelling	427	394	427	19,994	755	1,805	656	691	510	22	6
2011 - 2015	Tanker	Auxiliary	Zone 1	Maneuver	14	13	14	647	24	58	21	22	16	1	0
2011 - 2015	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2011 - 2015	Tanker Tugs	Propulsion	Zone 1	Maneuver	43	40	43	2,254	1	214	70	74	57	2	1
2011 - 2015	Tanker Tugs	Auxiliary	Zone 1	Maneuver	7	6	7	199	0	23	10	11	8	0	0
2011 - 2015	Tanker Tugs	Fugitives	Zone 1	-	-	-	-	-	-	-	1,663	1,663	-	-	-
2011 - 2015	Tanks	Standing	Zone 1	-	-	-	-	-	-	-	4,065	4,065	-	-	-
2011 - 2015	Tanks	Withdrawal	Zone 1	-	-	-	-	-	-	-	42	42	-	-	-
2011 - 2015	Loading	Zone 1	-	-	-	-	-	-	-	-	-	-	-	-	-
2011 - 2015	Subtotal	Zone 1	-	-	1,493	1,381	936	49,413	3,827	4,663	7,696	7,769	2,766	183	17
2011 - 2015	ITB	Propulsion	Zone 2	Maneuver	138	128	138	6,493	229	585	266	280	157	7	2
2011 - 2015	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2011 - 2015	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2011 - 2015	ITB	Auxiliary	Zone 2	Hotelling	66	60	66	2,469	116	227	101	106	75	3	1
2011 - 2015	ITB	Auxiliary	Zone 2	Maneuver	5	5	5	200	9	18	8	9	6	0	0
2011 - 2015	ITB Tug	Propulsion	Zone 2	Maneuver	44	41	44	2,305	1	219	72	76	59	2	1
2011 - 2015	ITB Tug	Auxiliary	Zone 2	Maneuver	7	6	7	203	0	24	11	11	8	0	0
2011 - 2015	Tanker	Propulsion	Zone 2	Maneuver	40	37	40	2,469	60	216	93	98	41	2	1
2011 - 2015	Tanker	Boiler	Zone 2	Hotelling	100	93	-	1,433	437	143	72	70	300	24	1
2011 - 2015	Tanker	Boiler	Zone 2	Maneuver	0	0	-	6	2	1	0	0	1	0	0
2011 - 2015	Tanker	Auxiliary	Zone 2	Hotelling	307	283	307	14,358	543	1,298	472	497	367	16	4
2011 - 2015	Tanker	Auxiliary	Zone 2	Maneuver	12	11	12	552	21	49	18	19	14	1	0
2011 - 2015	Tanker Tugs	Propulsion	Zone 2	Maneuver	33	30	33	1,711	1	163	53	56	44	2	0
2011 - 2015	Tanker Tugs	Auxiliary	Zone 2	Maneuver	5	5	5	151	0	18	8	8	6	0	0
2011 - 2015	Subtotal	Zone 2	-	-	757	700	657	32,351	1,419	2,961	1,173	1,230	1,077	58	11
2011 - 2015	ITB	Propulsion	Zone 3	At Sea	431	398	431	20,224	713	1,823	829	873	488	22	8
2011 - 2015	ITB	Auxiliary	Zone 3	At Sea	10	9	10	364	17	33	15	16	11	0	0
2011 - 2015	Tanker	Propulsion	Zone 3	At Sea	127	118	127	7,842	191	685	294	309	131	6	3
2011 - 2015	Tanker	Auxiliary	Zone 3	At Sea	18	17	18	879	33	78	28	30	22	1	0
2011 - 2015	Subtotal	Zone 3	At Sea	-	586	541	586	29,308	953	2,620	1,166	1,228	652	30	11
2011 - 2015	ITB	Propulsion	Zone 4	At Sea	482	445	482	22,622	797	2,040	927	976	546	24	8
2011 - 2015	ITB	Auxiliary	Zone 4	At Sea	11	10	11	400	19	37	16	17	12	1	0
2011 - 2015	Tanker	Propulsion	Zone 4	At Sea	141	130	141	8,629	212	759	325	343	145	7	3
2011 - 2015	Tanker	Auxiliary	Zone 4	At Sea	18	17	18	847	32	76	28	29	22	1	0
2011 - 2015	Subtotal	Zone 4	At Sea	-	652	602	652	32,497	1,060	2,912	1,297	1,365	725	33	12
2011 - 2015	ITB	Propulsion	Zone 5	At Sea	208	192	208	9,756	344	880	400	421	235	11	4
2011 - 2015	ITB	Auxiliary	Zone 5	At Sea	3	3	3	112	5	10	5	5	3	0	0
2011 - 2015	Tanker	Propulsion	Zone 5	At Sea	28	26	28	1,754	43	153	66	69	29	1	1
2011 - 2015	Tanker	Auxiliary	Zone 5	At Sea	2	2	2	108	4	10	3	4	3	0	0
2011 - 2015	Subtotal	Zone 5	At Sea	-	242	223	242	11,729	396	1,052	473	499	271	12	4
2011 - 2015	ITB	Propulsion	Zone 6	At Sea	-	-	-	-	-	-	-	-	4,240	189	65
2011 - 2015	ITB	Auxiliary	Zone 6	At Sea	-	-	-	-	-	-	-	-	61	3	1
2011 - 2015	Tanker	Propulsion	Zone 6	At Sea	-	-	-	-	-	-	-	-	1,347	66	27
2011 - 2015	Tanker	Auxiliary	Zone 6	At Sea	-	-	-	-	-	-	-	-	128	5	1
2011 - 2015	Subtotal (GHG Only)	Zone 6	At Sea	-	-	-	-	-	-	-	-	-	5,776	264	95
2011 - 2015	Annual Total	-	-	-	3,730	3,447	3,072	155,298	7,655	14,209	11,805	12,090	11,266	580	150

Vessel Activity and Assumed Engine Tiers						
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2011 - 2015	Vessel Type
-	60.2	-	-	-	60.2	ITB
5.2	17.4	2.8	-	-	25.4	Tanker
					13,634,731	bbl

Assumed Control for Tugs in 2023+ (Tier 4 Propulsion/Tier 3 Auxiliary)

2011 - 2015	ITB Tug	Propulsion	Zone 1	Maneuver	10	10	10	464	2	1,290	49	52	76	4	0
2011 - 2015	ITB Tug	Auxiliary	Zone 1	Maneuver	9	8	9	68	0	31	14	14	10	0	0
2011 - 2015	ITB Tug	Propulsion	Zone 2	Maneuver	6	6	6	270	1	749	28	30	44	2	0
2011 - 2015	ITB Tug	Auxiliary	Zone 2	Maneuver	5	5	5	40	0	18	8	8	6	0	0
2011 - 2015	Tanker Tug	Propulsion	Zone 1	Maneuver	10	10	10	471	2	1,307	50	52	77	4	0
2011 - 2015	Tanker Tug	Auxiliary	Zone 1	Maneuver	9	8	9	69	0	31	14	15	10	0	0
2011 - 2015	Tanker Tug	Propulsion	Zone 2	Maneuver	8	8	8	355	1	987	38	40	58	3	0
2011 - 2015	Tanker Tug	Auxiliary	Zone 2	Maneuver	7	6	7	52	0	24	10	11	8	0	0

Assumed Emissions for 20% Loading in Future Years

2011 - 2015	Loading	VRU	Zone 1	-	20	20	-	900	323	225	1,020	1,020	391	1	0
2011 - 2015	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2011 - 2015	Loading	Mobile	Zone 1	-	5	3	5	219	-	27	7	7	26	-	-
2011 - 2015	Loading	Fugitives	Zone 1	-	-	-	-	-	-	-	245	245	-	-	-

VSRP Mitigation (95% Tankers)

2011 - 2015	Tanker	Propulsion	Zone 3	At Sea	125	116	125	7,724	188	675	289	305	129	6	3
2011 - 2015	Tanker	Auxiliary	Zone 3	At Sea	19	17	19	883	33	78	28	30	22	1	0
2011 - 2015	Tanker	Propulsion	Zone 4	At Sea	138	127	138	8,442	207	743	318	335	142	7	3
2011 - 2015	Tanker	Auxiliary	Zone 4	At Sea	18	17	18	853	32	77	28	29	22	1	0

VSRP Compliance	Total Trips	Unmitigated Compliance		Mitigated Compliance				
		<20 nm	<40 nm trips	<20 nm	<40 nm trips			
2011 - 2015	ITB	602	602	100%	602	100%	602	100%
2011 - 2015	Tanker	252	208	83%	203	81%	240	95%
2011 - 2015	Total	854	810	95%	805	94%	842	99%

Assumed NOx control from implementing Tier 3 propulsion/auxiliary engines and phase out of Tier 0 propulsion/auxiliary engines for tankers

2011 - 2015	Tanker	Propulsion	0%	0%	0%	3%	17%	48%
2011 - 2015	Tanker	Auxiliary	0%	0%	0%	6%	17%	49%

Table B1.39 Operational Emissions for 2017

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2017	ITB	Propulsion	Zone 1	Maneuver	33	31	33	1,572	55	142	64	68	38	2	1
2017	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2017	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2017	ITB	Auxiliary	Zone 1	Hotelling	108	99	108	4,055	190	372	165	174	123	5	2
2017	ITB	Auxiliary	Zone 1	Maneuver	9	8	9	335	16	31	14	14	10	0	0
2017	ITB	Pump	Zone 1	Hotelling	206	190	206	7,747	364	711	316	333	235	10	3
2017	ITB Tug	Propulsion	Zone 1	Maneuver	75	69	75	3,927	2	373	122	129	100	4	1
2017	ITB Tug	Auxiliary	Zone 1	Maneuver	12	11	12	347	0	41	18	19	13	1	0
2017	Tanker	Propulsion	Zone 1	Maneuver	24	22	24	1,209	21	175	104	110	14	1	1
2017	Tanker	Boiler	Zone 1	Hotelling	566	526	-	8,091	2,468	809	405	396	1,692	138	4
2017	Tanker	Boiler	Zone 1	Maneuver	4	3	-	52	16	5	3	3	11	1	0
2017	Tanker	Auxiliary	Zone 1	Hotelling	437	403	437	20,466	772	1,847	672	707	523	22	6
2017	Tanker	Auxiliary	Zone 1	Maneuver	14	13	14	662	25	59	22	23	17	1	0
2017	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2017	Tanker Tugs	Propulsion	Zone 1	Maneuver	44	41	44	2,307	1	219	72	76	59	2	1
2017	Tanker Tugs	Auxiliary	Zone 1	Maneuver	7	6	7	204	0	24	11	11	8	0	0
2017	Tanker Tugs	Fugitives	Zone 1		-	-	-	-	-	-	1,663	1,663	-	-	-
2017	Tanks	Standing	Zone 1		-	-	-	-	-	-	4,065	4,065	-	-	-
2017	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	44	44	-	-	-
2017	Loading	VRU	Zone 1		20	20	-	936	336	234	1,061	1,061	407	1	0
2017	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2017	Loading	Mobile	Zone 1		5	3	5	219	-	27	7	7	26	-	-
2017	Loading	Fugitives	Zone 1		-	-	-	-	-	-	245	245	-	-	-
2017	Loading	Fugitives	Zone 1		-	-	-	-	-	-	-	-	-	-	-
2017	Subtotal		Zone 1		1,703	1,542	3,043	54,640	4,662	5,358	9,235	9,399	3,428	199	19
2017	ITB	Propulsion	Zone 2	Maneuver	145	134	145	6,795	240	613	278	293	164	7	3
2017	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2017	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2017	ITB	Auxiliary	Zone 2	Hotelling	69	63	69	2,584	121	237	105	111	78	3	1
2017	ITB	Auxiliary	Zone 2	Maneuver	6	5	6	210	10	19	9	9	6	0	0
2017	ITB Tug	Propulsion	Zone 2	Maneuver	46	43	46	2,412	1	229	75	79	61	3	1
2017	ITB Tug	Auxiliary	Zone 2	Maneuver	7	7	7	213	0	25	11	12	8	0	0
2017	ITB Tug	Propulsion	Zone 2	Maneuver	41	38	41	2,527	62	221	95	100	42	2	1
2017	Tanker	Boiler	Zone 2	Hotelling	103	95	-	1,467	447	147	73	72	307	25	1
2017	Tanker	Boiler	Zone 2	Maneuver	0	0	-	6	2	1	0	0	1	0	0
2017	Tanker	Auxiliary	Zone 2	Hotelling	314	290	314	14,697	555	1,328	483	509	376	16	4
2017	Tanker	Auxiliary	Zone 2	Maneuver	12	11	12	565	21	51	18	19	14	1	0
2017	Tanker Tugs	Propulsion	Zone 2	Maneuver	34	31	34	1,752	1	167	55	57	45	2	0
2017	Tanker Tugs	Auxiliary	Zone 2	Maneuver	5	5	5	155	0	18	8	8	6	0	0
2017	Subtotal		Zone 2		781	722	678	33,382	1,461	3,056	1,211	1,270	1,109	60	11
2017	ITB	Propulsion	Zone 3		451	416	451	21,164	746	1,908	867	913	511	23	8
2017	ITB	Auxiliary	Zone 3		10	9	10	381	18	35	16	16	12	1	0
2017	Tanker	Propulsion	Zone 3		130	120	130	8,028	195	702	301	317	134	7	3
2017	Tanker	Auxiliary	Zone 3		19	17	19	899	33	80	29	31	23	1	0
2017	Subtotal		Zone 3		610	563	610	30,472	993	2,725	1,213	1,277	679	31	11
2017	ITB	Propulsion	Zone 4		505	466	505	23,674	834	2,135	970	1,022	571	26	9
2017	ITB	Auxiliary	Zone 4		11	10	11	418	20	38	17	18	13	1	0
2017	Tanker	Propulsion	Zone 4		144	133	144	8,833	217	777	333	351	148	7	3
2017	Tanker	Auxiliary	Zone 4		18	17	18	867	33	78	28	30	22	1	0
2017	Subtotal		Zone 4		678	626	678	33,792	1,103	3,028	1,349	1,420	754	34	12
2017	ITB	Propulsion	Zone 5		218	201	218	10,210	360	921	418	441	246	11	4
2017	ITB	Auxiliary	Zone 5		3	3	3	117	5	11	5	5	4	0	0
2017	Tanker	Propulsion	Zone 5		29	27	29	1,795	44	157	67	71	30	1	1
2017	Tanker	Auxiliary	Zone 5		2	2	2	110	4	10	4	4	3	0	0
2017	Subtotal		Zone 5		252	233	252	12,232	413	1,098	494	520	283	13	4
2017	ITB	Propulsion	Zone 6										4,438	198	68
2017	ITB	Auxiliary	Zone 6										64	3	1
2017	Tanker	Propulsion	Zone 6										1,378	68	28
2017	Tanker	Auxiliary	Zone 6										131	6	2
2017	Subtotal (GHG Only)		Zone 6										6,011	275	99
2017	Annual Total				4,025	3,686	5,262	164,519	8,632	15,264	13,501	13,886	12,263	611	156
Vessel Activity and Assumed Engine Tiers															
Tier 0 Tier 1 Tier 2 Tier 3 Tier 4 2015 Vessel Type 2017 %Baseline															
- 63 - - - 60.2 ITB - 63.0 104.7%															
10 12 4 - - 25.4 Tanker - 26.0 102.4%															
13,251,089 bbl 13,786,433 104.0%															

Notes:
 Tankers, Tugs, and ITBs adjusted for increase in vessels since baseline
 Tanks (withdrawal) and loading adjusted for increase in throughput since baseline. Loading assumed 20% of throughput.

Table B1.40 Operational Emissions for 2018

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2018	ITB	Propulsion	Zone 1	Maneuver	34	31	34	1,597	56	144	65	69	39	2	1
2018	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2018	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2018	ITB	Auxiliary	Zone 1	Hotelling	109	101	109	4,119	193	378	168	177	125	6	2
2018	ITB	Auxiliary	Zone 1	Maneuver	9	8	9	341	16	31	14	15	10	0	0
2018	ITB	Pump	Zone 1	Hotelling	209	193	209	7,870	369	723	321	338	239	11	3
2018	ITB Tug	Propulsion	Zone 1	Maneuver	76	71	76	3,989	2	379	124	131	102	4	1
2018	ITB Tug	Auxiliary	Zone 1	Maneuver	12	11	12	352	0	41	18	19	14	1	0
2018	Tanker	Propulsion	Zone 1	Maneuver	25	23	25	1,256	22	182	108	114	15	1	1
2018	Tanker	Boiler	Zone 1	Hotelling	588	546	-	8,403	2,563	840	420	412	1,757	143	4
2018	Tanker	Boiler	Zone 1	Maneuver	4	3	-	54	16	5	3	3	11	1	0
2018	Tanker	Auxiliary	Zone 1	Hotelling	453	419	453	21,253	802	1,918	698	735	543	23	6
2018	Tanker	Auxiliary	Zone 1	Maneuver	15	13	15	688	26	62	22	24	17	1	0
2018	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2018	Tanker Tugs	Propulsion	Zone 1	Maneuver	46	42	46	2,396	1	228	75	79	61	3	1
2018	Tanker Tugs	Auxiliary	Zone 1	Maneuver	7	7	7	211	0	25	11	12	8	0	0
2018	Tanker	Fugitives	Zone 1		-	-	-	-	-	-	1,663	1,663	-	-	-
2018	Tanks	Standing	Zone 1		-	-	-	-	-	-	4,065	4,065	-	-	-
2018	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	44	44	-	-	-
2018	Loading		Zone 1		21	21	-	955	343	239	1,082	1,082	415	1	0
2018	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2018	Loading	Mobile	Zone 1		5	3	5	219	-	27	7	7	26	-	-
2018	Loading	Fugitives	Zone 1		-	-	-	-	-	-	245	245	-	-	-
2018	Loading	Fugitives	Zone 1		-	-	-	-	-	-	-	-	-	-	-
2018	Subtotal		Zone 1		1,752	1,588	3,071	56,213	4,806	5,510	9,317	9,484	3,534	206	19
2018	ITB	Propulsion	Zone 2	Maneuver	147	136	147	6,903	243	622	283	298	167	7	3
2018	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2018	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2018	ITB	Auxiliary	Zone 2	Hotelling	70	64	70	2,625	123	241	107	113	80	4	1
2018	ITB	Auxiliary	Zone 2	Maneuver	6	5	6	213	10	20	9	9	6	0	0
2018	ITB Tug	Propulsion	Zone 2	Maneuver	47	43	47	2,450	1	233	76	80	62	3	1
2018	ITB Tug	Auxiliary	Zone 2	Maneuver	7	7	7	216	0	25	11	12	8	0	0
2018	Tanker	Propulsion	Zone 2	Maneuver	43	39	43	2,625	64	230	98	104	44	2	1
2018	Tanker	Boiler	Zone 2	Hotelling	107	99	-	1,523	464	152	76	75	318	26	1
2018	Tanker	Boiler	Zone 2	Maneuver	0	0	-	6	2	1	0	0	1	0	0
2018	Tanker	Auxiliary	Zone 2	Hotelling	326	301	326	15,262	577	1,379	502	528	390	16	5
2018	Tanker	Auxiliary	Zone 2	Maneuver	12	11	12	587	22	53	19	20	15	1	0
2018	Tanker Tugs	Propulsion	Zone 2	Maneuver	35	32	35	1,819	1	173	57	60	46	2	1
2018	Tanker Tugs	Auxiliary	Zone 2	Maneuver	5	5	5	161	0	19	8	9	6	0	0
2018	Subtotal		Zone 2		805	744	698	34,390	1,508	3,148	1,247	1,307	1,145	62	11
2018	ITB	Propulsion	Zone 3		458	423	458	21,500	758	1,939	881	928	519	23	8
2018	ITB	Auxiliary	Zone 3		10	9	10	387	18	36	16	17	12	1	0
2018	Tanker	Propulsion	Zone 3		135	125	135	8,336	203	729	312	329	139	7	3
2018	Tanker	Auxiliary	Zone 3		20	18	20	934	35	83	30	32	23	1	0
2018	Subtotal		Zone 3		623	575	623	31,157	1,014	2,786	1,239	1,305	693	32	11
2018	ITB	Propulsion	Zone 4		513	473	513	24,049	848	2,168	986	1,038	580	26	9
2018	ITB	Auxiliary	Zone 4		11	10	11	425	20	39	17	18	13	1	0
2018	Tanker	Propulsion	Zone 4		150	138	150	9,173	225	807	346	364	154	8	3
2018	Tanker	Auxiliary	Zone 4		19	18	19	900	34	81	29	31	23	1	0
2018	Subtotal		Zone 4		693	640	693	34,548	1,126	3,096	1,378	1,452	770	35	13
2018	ITB	Propulsion	Zone 5		221	204	221	10,372	366	935	425	448	250	11	4
2018	ITB	Auxiliary	Zone 5		3	3	3	119	6	11	5	5	4	0	0
2018	Tanker	Propulsion	Zone 5		30	28	30	1,864	45	163	70	73	31	2	1
2018	Tanker	Auxiliary	Zone 5		2	2	2	115	4	10	4	4	3	0	0
2018	Subtotal		Zone 5		257	237	257	12,469	421	1,119	503	530	288	13	5
2018	ITB	Propulsion	Zone 6										4,508	201	69
2018	ITB	Auxiliary	Zone 6										65	3	1
2018	Tanker	Propulsion	Zone 6										1,431	70	29
2018	Tanker	Auxiliary	Zone 6										136	6	2
2018	Subtotal (GHG Only)		Zone 6										6,140	281	101
2018	Annual Total				4,130	3,784	5,342	168,778	8,875	15,658	13,685	14,078	12,569	627	160

Vessel Activity and Assumed Engine Tiers									
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2015	Vessel Type	2018	%Baseline	
-	64	-	-	-	60.2	ITB	64.0	106.3%	
10	12	4	1	-	25.4	Tanker	27.0	106.3%	
					13,251,089	bbl	14,062,162	106.1%	

Notes:
 Tankers, Tugs, and ITBs adjusted for increase in vessels since baseline
 Tanks (withdrawal) and loading adjusted for increase in throughput since baseline. Loading assumed 20% of throughput.

Table B1.41 Operational Emissions for 2019

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2019	ITB	Propulsion	Zone 1	Maneuver	35	32	35	1,622	57	146	66	70	39	2	1
2019	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2019	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2019	ITB	Auxiliary	Zone 1	Hotelling	111	102	111	4,183	196	384	171	180	127	6	2
2019	ITB	Auxiliary	Zone 1	Maneuver	9	8	9	346	16	32	14	15	11	0	0
2019	ITB	Pump	Zone 1	Hotelling	212	196	212	7,993	375	734	326	344	243	11	3
2019	ITB Tug	Propulsion	Zone 1	Maneuver	78	72	78	4,051	2	385	126	133	103	4	1
2019	ITB Tug	Auxiliary	Zone 1	Maneuver	12	11	12	358	0	42	19	20	14	1	0
2019	Tanker	Propulsion	Zone 1	Maneuver	25	23	25	1,256	22	182	108	114	15	1	1
2019	Tanker	Boiler	Zone 1	Hotelling	588	546	-	8,403	2,563	840	420	412	1,757	143	4
2019	Tanker	Boiler	Zone 1	Maneuver	4	3	-	54	16	5	3	3	11	1	0
2019	Tanker	Auxiliary	Zone 1	Hotelling	453	419	453	21,253	802	1,918	698	735	543	23	6
2019	Tanker	Auxiliary	Zone 1	Maneuver	15	13	15	688	26	62	22	24	17	1	0
2019	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2019	Tanker Tugs	Propulsion	Zone 1	Maneuver	46	42	46	2,396	1	228	75	79	61	3	1
2019	Tanker Tugs	Auxiliary	Zone 1	Maneuver	7	7	7	211	0	25	11	12	8	0	0
2019	Fugitives		Zone 1		-	-	-	-	-	-	1,663	1,663	-	-	-
2019	Tanks	Standing	Zone 1		-	-	-	-	-	-	4,065	4,065	-	-	-
2019	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	45	45	-	-	-
2019	Loading		Zone 1		21	21	-	974	350	243	1,104	1,104	423	1	0
2019	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2019	Loading	Mobile	Zone 1		5	3	5	219	-	27	7	7	26	-	-
2019	Loading	Fugitives	Zone 1		-	-	-	-	-	-	245	245	-	-	-
Subtotal			Zone 1		1,760	1,595	3,078	56,518	4,822	5,541	9,351	9,518	3,550	206	20
2019	ITB	Propulsion	Zone 2	Maneuver	149	138	149	7,011	247	632	287	303	169	8	3
2019	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2019	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2019	ITB	Auxiliary	Zone 2	Hotelling	71	65	71	2,666	125	245	109	115	81	4	1
2019	ITB	Auxiliary	Zone 2	Maneuver	6	5	6	216	10	20	9	9	7	0	0
2019	ITB Tug	Propulsion	Zone 2	Maneuver	48	44	48	2,488	1	237	77	82	63	3	1
2019	ITB Tug	Auxiliary	Zone 2	Maneuver	7	7	7	220	0	26	11	12	8	0	0
2019	Tanker	Propulsion	Zone 2	Maneuver	43	39	43	2,625	64	230	98	104	44	2	1
2019	Tanker	Boiler	Zone 2	Hotelling	107	99	-	1,523	464	152	76	75	318	26	1
2019	Tanker	Boiler	Zone 2	Maneuver	0	0	-	6	2	1	0	0	1	0	0
2019	Tanker	Auxiliary	Zone 2	Hotelling	326	301	326	15,262	577	1,379	502	528	390	16	5
2019	Tanker	Auxiliary	Zone 2	Maneuver	12	11	12	587	22	53	19	20	15	1	0
2019	Tanker Tugs	Propulsion	Zone 2	Maneuver	35	32	35	1,819	1	173	57	60	46	2	1
2019	Tanker Tugs	Auxiliary	Zone 2	Maneuver	5	5	5	161	0	19	8	9	6	0	0
Subtotal			Zone 2		809	748	702	34,584	1,514	3,166	1,254	1,315	1,150	62	11
2019	ITB	Propulsion	Zone 3		465	430	465	21,836	770	1,969	895	942	527	24	8
2019	ITB	Auxiliary	Zone 3		10	10	10	393	18	36	16	17	12	1	0
2019	Tanker	Propulsion	Zone 3		135	125	135	8,336	203	729	312	329	139	7	3
2019	Tanker	Auxiliary	Zone 3		20	18	20	934	35	83	30	32	23	1	0
Subtotal			Zone 3		631	582	631	31,499	1,026	2,816	1,253	1,320	701	32	11
2019	ITB	Propulsion	Zone 4		521	480	521	24,425	861	2,202	1,001	1,054	589	26	9
2019	ITB	Auxiliary	Zone 4		11	11	11	432	20	40	18	19	13	1	0
2019	Tanker	Propulsion	Zone 4		150	138	150	9,173	225	807	346	364	154	8	3
2019	Tanker	Auxiliary	Zone 4		19	18	19	900	34	81	29	31	23	1	0
Subtotal			Zone 4		701	647	701	34,930	1,140	3,130	1,394	1,468	779	35	13
2019	ITB	Propulsion	Zone 5		224	207	224	10,534	371	950	432	455	254	11	4
2019	ITB	Auxiliary	Zone 5		3	3	3	120	6	11	5	5	4	0	0
2019	Tanker	Propulsion	Zone 5		30	28	30	1,864	45	163	70	73	31	2	1
2019	Tanker	Auxiliary	Zone 5		2	2	2	115	4	10	4	4	3	0	0
Subtotal			Zone 5		260	240	260	12,633	426	1,134	510	537	292	13	5
2019	ITB	Propulsion	Zone 6										4,578	205	71
2019	ITB	Auxiliary	Zone 6										66	3	1
2019	Tanker	Propulsion	Zone 6										1,431	70	29
2019	Tanker	Auxiliary	Zone 6										136	6	2
Subtotal (GHG Only)			Zone 6										6,212	284	102
Annual Total					4,161	3,812	5,372	170,164	8,929	15,787	13,763	14,158	12,684	632	162

Vessel Activity and Assumed Engine Tiers									
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2015	Vessel Type	2019	%Baseline	
-	65	-	-	-	60.2	ITB	65.0	108.0%	
9	12	5	1	-	25.4	Tanker	27.0	106.3%	
					13,251,089	bbl	14,343,405	108.2%	

Notes:
 Tankers, Tugs, and ITBs adjusted for increase in vessels since baseline
 Tanks (withdrawal) and loading adjusted for increase in throughput since baseline. Loading assumed 20% of throughput.
 Tankers propulsion and auxiliary engines in Zones 3 and 4 (<40 nm) calculated based on VSRP compliance rate during baseline period.

VSRP Compliance	Total Trips	Unmitigated Compliance			
		<20 nm	20-40 nm	>40 nm	>80 nm
2019 ITB	65	65	100%	65	100%
2019 Tanker	27	22	83%	22	81%
2019 Total	92	87	95%	87	94%

Table B1.42 Operational Emissions for 2019 (Mitigated)

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2019	ITB	Propulsion	Zone 1	Maneuver	35	32	35	1,622	57	146	66	70	39	2	1
2019	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2019	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2019	ITB	Auxiliary	Zone 1	Hotelling	111	102	111	4,183	196	384	171	180	127	6	2
2019	ITB	Auxiliary	Zone 1	Maneuver	9	8	9	346	16	32	14	15	11	0	0
2019	ITB	Pump	Zone 1	Hotelling	212	196	212	7,993	375	734	326	344	243	11	3
2019	ITB Tug	Propulsion	Zone 1	Maneuver	78	72	78	4,051	2	385	126	133	103	4	1
2019	ITB Tug	Auxiliary	Zone 1	Maneuver	12	11	12	358	0	42	19	20	14	1	0
2019	Tanker	Propulsion	Zone 1	Maneuver	25	23	25	1,256	22	182	108	114	15	1	1
2019	Tanker	Boiler	Zone 1	Hotelling	588	546	-	8,403	2,563	840	420	412	1,757	143	4
2019	Tanker	Boiler	Zone 1	Maneuver	4	3	-	54	16	5	3	3	11	1	0
2019	Tanker	Auxiliary	Zone 1	Hotelling	453	419	453	21,253	802	1,918	698	735	543	23	6
2019	Tanker	Auxiliary	Zone 1	Maneuver	15	13	15	688	26	62	22	24	17	1	0
2019	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2019	Tanker Tugs	Propulsion	Zone 1	Maneuver	46	42	46	2,396	1	228	75	79	61	3	1
2019	Tanker Tugs	Auxiliary	Zone 1	Maneuver	7	7	7	211	0	25	11	12	8	0	0
2019	Tanker Tugs	Fugitives	Zone 1		-	-	-	-	-	-	1,663	1,663	-	-	-
2019	Tanks	Standing	Zone 1		-	-	-	-	-	-	4,065	4,065	-	-	-
2019	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	45	45	-	-	-
2019	Loading		Zone 1		21	21	-	974	350	243	1,104	1,104	423	1	0
2019	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2019	Loading	Mobile	Zone 1		5	3	5	219	-	27	7	7	26	-	-
2019	Loading	Fugitives	Zone 1		-	-	-	-	-	-	245	245	-	-	-
2019	Loading	Fugitives	Zone 1		-	-	-	-	-	-	-	-	-	-	-
2019	Subtotal		Zone 1		1,760	1,595	3,078	56,518	4,822	5,541	9,351	9,518	3,550	206	20
2019	ITB	Propulsion	Zone 2	Maneuver	149	138	149	7,011	247	632	287	303	169	8	3
2019	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2019	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2019	ITB	Auxiliary	Zone 2	Hotelling	71	65	71	2,666	125	245	109	115	81	4	1
2019	ITB	Auxiliary	Zone 2	Maneuver	6	5	6	216	10	20	9	9	7	0	0
2019	ITB Tug	Propulsion	Zone 2	Maneuver	48	44	48	2,488	1	237	77	82	63	3	1
2019	ITB Tug	Auxiliary	Zone 2	Maneuver	7	7	7	220	0	26	11	12	8	0	0
2019	Tanker	Propulsion	Zone 2	Maneuver	43	39	43	2,625	64	230	98	104	44	2	1
2019	Tanker	Boiler	Zone 2	Hotelling	107	99	-	1,523	464	152	76	75	318	26	1
2019	Tanker	Boiler	Zone 2	Maneuver	0	0	-	6	2	1	0	0	1	0	0
2019	Tanker	Auxiliary	Zone 2	Hotelling	326	301	326	15,262	577	1,379	502	528	390	16	5
2019	Tanker	Auxiliary	Zone 2	Maneuver	12	11	12	587	22	53	19	20	15	1	0
2019	Tanker Tugs	Propulsion	Zone 2	Maneuver	35	32	35	1,819	1	173	57	60	46	2	1
2019	Tanker Tugs	Auxiliary	Zone 2	Maneuver	5	5	5	161	0	19	8	9	6	0	0
2019	Subtotal		Zone 2		809	748	702	34,584	1,514	3,166	1,254	1,315	1,150	62	11
2019	ITB	Propulsion	Zone 3		465	430	465	21,836	770	1,969	895	942	527	24	8
2019	ITB	Auxiliary	Zone 3		10	10	10	393	18	36	16	17	12	1	0
2019	Tanker	Propulsion	Zone 3		133	123	133	8,211	200	718	308	324	137	7	3
2019	Tanker	Auxiliary	Zone 3		20	18	20	939	35	83	30	32	24	1	0
2019	Subtotal		Zone 3		629	580	629	31,379	1,023	2,806	1,249	1,315	699	32	11
2019	ITB	Propulsion	Zone 4		521	480	521	24,425	861	2,202	1,001	1,054	589	26	9
2019	ITB	Auxiliary	Zone 4		11	11	11	432	20	40	18	19	13	1	0
2019	Tanker	Propulsion	Zone 4		147	135	147	8,974	220	790	338	356	151	7	3
2019	Tanker	Auxiliary	Zone 4		19	18	19	907	34	82	30	31	23	1	0
2019	Subtotal		Zone 4		698	644	698	34,738	1,135	3,113	1,387	1,460	776	35	13
2019	ITB	Propulsion	Zone 5		224	207	224	10,534	371	950	432	455	254	11	4
2019	ITB	Auxiliary	Zone 5		3	3	3	120	6	11	5	5	4	0	0
2019	Tanker	Propulsion	Zone 5		30	28	30	1,864	45	163	70	73	31	2	1
2019	Tanker	Auxiliary	Zone 5		2	2	2	115	4	10	4	4	3	0	0
2019	Subtotal		Zone 5		260	240	260	12,633	426	1,134	510	537	292	13	5
2019	ITB	Propulsion	Zone 6										4,578	205	71
2019	ITB	Auxiliary	Zone 6										66	3	1
2019	Tanker	Propulsion	Zone 6										1,431	70	29
2019	Tanker	Auxiliary	Zone 6										136	6	2
2019	Subtotal (GHG Only)		Zone 6										6,212	284	102
2019	Annual Total				4,156	3,808	5,367	169,852	8,921	15,760	13,751	14,146	12,679	632	162

Vessel Activity and Assumed Engine Tiers						2015	Vessel Type	2019	%Baseline
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4					
-	65	-	-	-	-	60.2	ITB	65.0	108.0%
9	12	5	1	-	-	25.4	Tanker	27.0	106.3%
						13,251,089	bbl	14,343,405	108.2%

Notes:
 Tankers, Tugs, and ITBs adjusted for increase in vessels since baseline
 Tanks (withdrawal) and loading adjusted for increase in throughput since baseline. Loading assumed 20% of throughput.
 Tankers propulsion and auxiliary engines in Zones 3 and 4 (<40 nm) adjusted for 95% tankers compliance with VSRP

VSRP Compliance	Total Trips	Unmitigated Compliance		Mitigated Compliance			
		<20 nm	<40 nm trips	<20 nm	<40 nm trips		
2019 ITB	65	65	100%	65	100%	65	100%
2019 Tanker	27	22	83%	22	81%	26	95%
2019 Total	92	87	95%	87	94%	91	99%

Table B1.43 Operational Emissions for 2031

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2031	ITB	Propulsion	Zone 1	Maneuver	31	29	31	1,472	52	133	60	64	36	2	1
2031	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2031	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2031	ITB	Auxiliary	Zone 1	Hotelling	101	93	101	3,797	178	349	155	163	115	5	1
2031	ITB	Auxiliary	Zone 1	Maneuver	8	8	8	314	15	29	13	13	10	0	0
2031	ITB	Pump	Zone 1	Hotelling	192	178	192	7,255	341	666	296	312	220	10	3
2031	ITB Tug	Propulsion	Zone 1	Maneuver	10	10	10	455	2	1,264	48	51	75	4	0
2031	ITB Tug	Auxiliary	Zone 1	Maneuver	9	8	9	67	0	30	13	14	10	0	0
2031	Tanker	Propulsion	Zone 1	Maneuver	54	50	54	2,291	48	397	236	249	33	2	2
2031	Tanker	Boiler	Zone 1	Hotelling	1,285	1,193	-	18,361	5,600	1,836	918	900	3,839	312	8
2031	Tanker	Boiler	Zone 1	Maneuver	8	8	-	117	36	12	6	6	24	2	0
2031	Tanker	Auxiliary	Zone 1	Hotelling	991	915	991	38,413	1,753	4,192	1,524	1,605	1,186	50	14
2031	Tanker	Auxiliary	Zone 1	Maneuver	32	29	32	1,243	56	135	49	52	38	2	0
2031	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2031	Tanker Tugs	Propulsion	Zone 1	Maneuver	24	24	24	1,093	4	3,036	115	121	180	9	1
2031	Tanker Tugs	Auxiliary	Zone 1	Maneuver	21	19	21	161	1	72	32	34	24	1	0
2031	Tanker Tugs	Fugitives	Zone 1		-	-	-	-	-	-	1,663	1,663	-	-	-
2031	Tanks	Standing	Zone 1		-	-	-	-	-	-	4,065	4,065	-	-	-
2031	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	57	57	-	-	-
2031	Loading		Zone 1		27	27	-	1,235	444	309	1,400	1,400	537	1	0
2031	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2031	Loading	Mobile	Zone 1		5	3	5	219	-	27	7	7	26	-	-
2031	Loading	Fugitives	Zone 1		-	-	-	-	-	-	245	245	-	-	-
2031	Loading	Fugitives	Zone 1		-	-	-	-	-	-	-	-	-	-	-
2031	Subtotal		Zone 1		2,938	2,690	3,549	79,005	8,923	12,774	11,067	11,272	6,504	410	32
2031	ITB	Propulsion	Zone 2	Maneuver	136	125	136	6,364	224	574	261	275	154	7	2
2031	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2031	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2031	ITB	Auxiliary	Zone 2	Hotelling	64	59	64	2,420	114	222	99	104	73	3	1
2031	ITB	Auxiliary	Zone 2	Maneuver	5	5	5	196	9	18	8	8	6	0	0
2031	ITB Tug	Propulsion	Zone 2	Maneuver	6	6	6	264	1	734	28	29	43	2	0
2031	ITB Tug	Auxiliary	Zone 2	Maneuver	5	5	5	39	0	18	8	8	6	0	0
2031	Tanker	Propulsion	Zone 2	Maneuver	93	86	93	4,788	140	502	215	227	96	5	2
2031	Tanker	Boiler	Zone 2	Hotelling	233	216	-	3,328	1,015	333	166	163	696	57	2
2031	Tanker	Boiler	Zone 2	Maneuver	1	1	-	14	4	1	1	1	3	0	0
2031	Tanker	Auxiliary	Zone 2	Hotelling	712	658	712	27,585	1,261	3,014	1,096	1,154	853	36	10
2031	Tanker	Auxiliary	Zone 2	Maneuver	27	25	27	1,061	48	115	42	44	32	1	0
2031	Tanker Tugs	Propulsion	Zone 2	Maneuver	18	18	18	826	3	2,294	87	92	136	6	1
2031	Tanker Tugs	Auxiliary	Zone 2	Maneuver	16	15	16	122	0	55	24	26	18	1	0
2031	Subtotal		Zone 2		1,317	1,219	1,083	47,006	2,819	7,879	2,035	2,131	2,116	119	19
2031	ITB	Propulsion	Zone 3		422	390	422	19,821	699	1,787	812	855	478	21	7
2031	ITB	Auxiliary	Zone 3		9	9	9	356	17	33	15	15	11	0	0
2031	Tanker	Propulsion	Zone 3		296	273	296	15,209	444	1,592	682	719	304	15	6
2031	Tanker	Auxiliary	Zone 3		43	40	43	1,688	76	181	66	69	51	2	1
2031	Subtotal		Zone 3		770	711	770	37,074	1,235	3,593	1,575	1,659	844	39	14
2031	ITB	Propulsion	Zone 4		472	436	472	22,171	781	1,999	909	957	535	24	8
2031	ITB	Auxiliary	Zone 4		10	10	10	392	18	36	16	17	12	1	0
2031	Tanker	Propulsion	Zone 4		328	302	328	16,735	491	1,764	756	796	337	17	7
2031	Tanker	Auxiliary	Zone 4		42	39	42	1,627	74	177	64	68	50	2	1
2031	Subtotal		Zone 4		852	787	852	40,924	1,365	3,976	1,745	1,838	934	43	16
2031	ITB	Propulsion	Zone 5		204	188	204	9,561	337	862	392	413	231	10	4
2031	ITB	Auxiliary	Zone 5		3	3	3	109	5	10	4	5	3	0	0
2031	Tanker	Propulsion	Zone 5		66	61	66	3,401	99	355	152	160	68	3	1
2031	Tanker	Auxiliary	Zone 5		5	5	5	207	9	22	8	9	6	0	0
2031	Subtotal		Zone 5		278	257	278	13,279	450	1,250	557	586	308	14	5
2031	ITB	Propulsion	Zone 6										4,156	186	64
2031	ITB	Auxiliary	Zone 6										60	3	1
2031	Tanker	Propulsion	Zone 6										3,128	154	64
2031	Tanker	Auxiliary	Zone 6										297	13	3
2031	Subtotal (GHG Only)		Zone 6										7,640	355	132
2031	Annual Total				6,156	5,663	6,533	217,289	14,792	29,472	16,979	17,485	18,347	980	218
Vessel Activity and Assumed Engine Tiers															
					Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2015	Vessel Type	2031	%Baseline		
					-	59	-	-	-	60.2	ITB	59.0	98.0%		
					9	23	16	11	-	25.4	Tanker	59.0	232.3%		
										13,251,089	bbl	18,190,906	137.3%		

Notes:
 Tankers, Tugs, and ITBs adjusted for increase in vessels since baseline
 Tanks (withdrawal) and loading adjusted for increase in throughput since baseline. Loading assumed 20% of throughput.
 Tanker NOx adjusted for phase in of Tier 3 propulsion/auxiliary engines since baseline.
 Tugs adjusted for replacement with Tier 4 propulsion/Tier 3 auxiliary engines.
 Tankers propulsion and auxiliary engines in Zones 3 and 4 (<40 nm) calculated based on VSRP compliance rate during baseline period.

Table B1.44 Operational Emissions for 2031 (Mitigated)

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2031	ITB	Propulsion	Zone 1	Maneuver	31	29	31	1,472	52	133	60	64	36	2	1
2031	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2031	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2031	ITB	Auxiliary	Zone 1	Hotelling	101	93	101	3,797	178	349	155	163	115	5	1
2031	ITB	Auxiliary	Zone 1	Maneuver	8	8	8	314	15	29	13	13	10	0	0
2031	ITB	Pump	Zone 1	Hotelling	192	178	192	7,255	341	666	296	312	220	10	3
2031	ITB Tug	Propulsion	Zone 1	Maneuver	10	10	10	455	2	1,264	48	51	75	4	0
2031	ITB Tug	Auxiliary	Zone 1	Maneuver	9	8	9	67	0	30	13	14	10	0	0
2031	Tanker	Propulsion	Zone 1	Maneuver	54	50	54	2,291	48	397	236	249	33	2	2
2031	Tanker	Boiler	Zone 1	Hotelling	1,285	1,193	-	18,361	5,600	1,836	918	900	3,839	312	8
2031	Tanker	Boiler	Zone 1	Maneuver	8	8	-	117	36	12	6	6	24	2	0
2031	Tanker	Auxiliary	Zone 1	Hotelling	991	915	991	38,413	1,753	4,192	1,524	1,605	1,186	50	14
2031	Tanker	Auxiliary	Zone 1	Maneuver	32	29	32	1,243	56	135	49	52	38	2	0
2031	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2031	Tanker Tugs	Propulsion	Zone 1	Maneuver	24	24	24	1,093	4	3,036	115	121	180	9	1
2031	Tanker Tugs	Auxiliary	Zone 1	Maneuver	21	19	21	161	1	72	32	34	24	1	0
2031	Tanker Tugs	Fugitives	Zone 1	-	-	-	-	-	-	-	1,663	1,663	-	-	-
2031	Tanks	Standing	Zone 1	-	-	-	-	-	-	-	4,065	4,065	-	-	-
2031	Tanks	Withdrawal	Zone 1	-	-	-	-	-	-	-	57	57	-	-	-
2031	Loading	-	Zone 1	-	27	27	-	1,235	444	309	1,400	1,400	537	1	0
2031	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2031	Loading	Mobile	Zone 1	-	5	3	5	219	-	27	7	7	26	-	-
2031	Loading	Fugitives	Zone 1	-	-	-	-	-	-	-	245	245	-	-	-
2031	Loading	Fugitives	Zone 1	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal			Zone 1		2,938	2,690	3,549	79,005	8,923	12,774	11,067	11,272	6,504	410	32
2031	ITB	Propulsion	Zone 2	Maneuver	136	125	136	6,364	224	574	261	275	154	7	2
2031	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2031	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2031	ITB	Auxiliary	Zone 2	Hotelling	64	59	64	2,420	114	222	99	104	73	3	1
2031	ITB	Auxiliary	Zone 2	Maneuver	5	5	5	196	9	18	8	8	6	0	0
2031	ITB Tug	Propulsion	Zone 2	Maneuver	6	6	6	264	1	734	28	29	43	2	0
2031	ITB Tug	Auxiliary	Zone 2	Maneuver	5	5	5	39	0	18	8	8	6	0	0
2031	Tanker	Propulsion	Zone 2	Maneuver	93	86	93	4,788	140	502	215	227	96	5	2
2031	Tanker	Boiler	Zone 2	Hotelling	233	216	-	3,328	1,015	333	166	163	696	57	2
2031	Tanker	Boiler	Zone 2	Maneuver	1	1	-	14	4	1	1	1	3	0	0
2031	Tanker	Auxiliary	Zone 2	Hotelling	712	658	712	27,585	1,261	3,014	1,096	1,154	853	36	10
2031	Tanker	Auxiliary	Zone 2	Maneuver	27	25	27	1,061	48	115	42	44	32	1	0
2031	Tanker Tugs	Propulsion	Zone 2	Maneuver	18	18	18	826	3	2,294	87	92	136	6	1
2031	Tanker Tugs	Auxiliary	Zone 2	Maneuver	16	15	16	122	0	55	24	26	18	1	0
Subtotal			Zone 2		1,317	1,219	1,083	47,006	2,819	7,879	2,035	2,131	2,116	119	19
2031	ITB	Propulsion	Zone 3	-	422	390	422	19,821	699	1,787	812	855	478	21	7
2031	ITB	Auxiliary	Zone 3	-	9	9	9	356	17	33	15	15	11	0	0
2031	Tanker	Propulsion	Zone 3	-	291	269	291	17,942	437	1,568	672	708	299	15	6
2031	Tanker	Auxiliary	Zone 3	-	43	40	43	2,051	76	182	66	70	51	2	1
Subtotal			Zone 3		766	707	766	40,171	1,228	3,570	1,565	1,648	840	39	14
2031	ITB	Propulsion	Zone 4	-	472	436	472	22,171	781	1,999	909	957	535	24	8
2031	ITB	Auxiliary	Zone 4	-	10	10	10	392	18	36	16	17	12	1	0
2031	Tanker	Propulsion	Zone 4	-	320	296	320	19,610	481	1,726	740	779	329	16	7
2031	Tanker	Auxiliary	Zone 4	-	42	39	42	1,983	75	179	65	68	51	2	1
Subtotal			Zone 4		846	781	846	44,154	1,355	3,939	1,729	1,821	927	43	16
2031	ITB	Propulsion	Zone 5	-	204	188	204	9,561	337	862	392	413	231	10	4
2031	ITB	Auxiliary	Zone 5	-	3	3	3	109	5	10	4	5	3	0	0
2031	Tanker	Propulsion	Zone 5	-	66	61	66	3,401	99	355	152	160	68	3	1
2031	Tanker	Auxiliary	Zone 5	-	5	5	5	207	9	22	8	9	6	0	0
Subtotal			Zone 5		278	257	278	13,279	450	1,250	557	586	308	14	5
2031	ITB	Propulsion	Zone 6	-	-	-	-	-	-	-	-	-	4,156	186	64
2031	ITB	Auxiliary	Zone 6	-	-	-	-	-	-	-	-	-	60	3	1
2031	Tanker	Propulsion	Zone 6	-	-	-	-	-	-	-	-	-	3,128	154	64
2031	Tanker	Auxiliary	Zone 6	-	-	-	-	-	-	-	-	-	297	13	3
Subtotal (GHG Only)			Zone 6		-	-	-	-	-	-	-	-	7,640	355	132
Annual Total					6,145	5,653	6,522	223,616	14,775	29,412	16,953	17,458	18,335	979	218

Vessel Activity and Assumed Engine Tiers								
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2015	Vessel Type	2031	%Baseline
-	59	-	-	-	60.2	ITB	59.0	98.0%
9	23	16	11	-	25.4	Tanker	59.0	232.3%
					13,251,089	bbl	18,190,906	137.3%

Notes:
 Tankers, Tugs, and ITBs adjusted for increase in vessels since baseline
 Tanks (withdrawal) and loading adjusted for increase in throughput since baseline. Loading assumed 20% of throughput.
 Tanker NOx adjusted for phase in of Tier 3 propulsion/auxiliary engines since baseline.
 Tugs adjusted for replacement with Tier 4 propulsion/Tier 3 auxiliary engines.
 Tankers propulsion and auxiliary engines in Zones 3 and 4 (<40 nm) adjusted for 95% tankers compliance with VSRP

VSRP Compliance	Total Trips	Unmitigated Compliance				Mitigated Compliance			
		<20 nm	20-40 nm	40-60 nm	>60 nm	<20 nm	20-40 nm	40-60 nm	>60 nm
2031 ITB	59	59	100%	59	100%	59	100%	59	100%
2031 Tanker	59	49	83%	48	81%	56	95%	56	95%
2031 Total	118	108	92%	107	90%	115	97%	115	97%

Table B1.45 Operational Emissions for 2047

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2047	ITB	Propulsion	Zone 1	Maneuver	43	40	43	2,021	71	182	83	87	49	2	1
2047	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2047	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2047	ITB	Auxiliary	Zone 1	Hotelling	138	128	138	5,213	245	479	213	224	158	7	2
2047	ITB	Auxiliary	Zone 1	Maneuver	11	11	11	431	20	40	18	19	13	1	0
2047	ITB	Pump	Zone 1	Hotelling	264	244	264	9,961	468	915	407	428	302	13	4
2047	ITB Tug	Propulsion	Zone 1	Maneuver	14	14	14	625	2	1,735	66	69	103	5	1
2047	ITB Tug	Auxiliary	Zone 1	Maneuver	12	11	12	92	0	41	18	19	14	1	0
2047	Tanker	Propulsion	Zone 1	Maneuver	74	68	74	1,974	66	546	324	342	45	3	3
2047	Tanker	Boiler	Zone 1	Hotelling	1,765	1,638	-	25,208	7,688	2,521	1,260	1,235	5,271	429	11
2047	Tanker	Boiler	Zone 1	Maneuver	11	10	-	161	49	16	8	8	34	3	0
2047	Tanker	Auxiliary	Zone 1	Hotelling	1,360	1,256	1,360	32,568	2,407	5,755	2,093	2,204	1,628	69	19
2047	Tanker	Auxiliary	Zone 1	Maneuver	44	40	44	1,054	77	185	67	71	52	2	1
2047	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2047	Tanker Tugs	Propulsion	Zone 1	Maneuver	33	33	33	1,501	5	4,168	158	167	247	12	2
2047	Tanker Tugs	Auxiliary	Zone 1	Maneuver	29	27	29	221	1	99	44	47	33	1	0
2047	Tanker Tugs	Fugitives	Zone 1		-	-	-	-	-	-	1,663	1,663	-	-	-
2047	Tanks	Standing	Zone 1		-	-	-	-	-	-	4,065	4,065	-	-	-
2047	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	79	79	-	-	-
2047	Loading		Zone 1		37	37	-	1,695	609	424	1,922	1,922	737	1	0
2047	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2047	Loading	Mobile	Zone 1		5	3	5	219	-	27	7	7	26	-	-
2047	Loading	Fugitives	Zone 1		-	-	-	-	-	-	245	245	-	-	-
2047	Subtotal		Zone 1		3,980	3,656	4,098	85,455	12,102	17,420	12,903	13,152	8,863	559	44
2047	ITB	Propulsion	Zone 2	Maneuver	186	172	186	8,737	308	788	358	377	211	9	3
2047	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2047	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2047	ITB	Auxiliary	Zone 2	Hotelling	88	81	88	3,323	156	305	136	143	101	4	1
2047	ITB	Auxiliary	Zone 2	Maneuver	7	7	7	270	13	25	11	12	8	0	0
2047	ITB Tug	Propulsion	Zone 2	Maneuver	8	8	8	363	1	1,007	38	40	60	3	0
2047	ITB Tug	Auxiliary	Zone 2	Maneuver	7	6	7	53	0	24	11	11	8	0	0
2047	Tanker	Propulsion	Zone 2	Maneuver	128	118	128	4,126	192	689	295	311	132	6	3
2047	Tanker	Boiler	Zone 2	Hotelling	320	297	-	4,569	1,393	457	228	224	955	78	2
2047	Tanker	Boiler	Zone 2	Maneuver	1	1	-	19	6	2	1	1	4	0	0
2047	Tanker	Auxiliary	Zone 2	Hotelling	978	903	978	23,387	1,731	4,138	1,505	1,585	1,171	49	14
2047	Tanker	Auxiliary	Zone 2	Maneuver	37	34	37	900	66	158	57	60	45	2	1
2047	Tanker Tugs	Propulsion	Zone 2	Maneuver	25	25	25	1,134	4	3,149	120	126	186	9	1
2047	Tanker Tugs	Auxiliary	Zone 2	Maneuver	22	20	22	167	1	75	33	35	25	1	0
2047	Subtotal		Zone 2		1,808	1,673	1,487	47,046	3,870	10,817	2,794	2,925	2,905	163	25
2047	ITB	Propulsion	Zone 3		580	535	580	27,211	959	2,453	1,115	1,174	657	29	10
2047	ITB	Auxiliary	Zone 3		13	12	13	489	23	45	20	21	15	1	0
2047	Tanker	Propulsion	Zone 3		406	375	406	13,105	609	2,186	937	987	417	21	8
2047	Tanker	Auxiliary	Zone 3		59	54	59	1,431	104	249	90	95	70	3	1
2047	Subtotal		Zone 3		1,058	976	1,058	42,238	1,695	4,933	2,162	2,277	1,159	54	20
2047	ITB	Propulsion	Zone 4		649	599	649	30,438	1,073	2,744	1,247	1,314	734	33	11
2047	ITB	Auxiliary	Zone 4		14	13	14	538	25	49	22	23	16	1	0
2047	Tanker	Propulsion	Zone 4		450	415	450	14,421	675	2,422	1,038	1,093	462	23	9
2047	Tanker	Auxiliary	Zone 4		57	53	57	1,379	102	243	88	93	69	3	1
2047	Subtotal		Zone 4		1,170	1,080	1,170	46,776	1,874	5,459	2,396	2,523	1,282	59	22
2047	ITB	Propulsion	Zone 5		280	258	280	13,127	463	1,184	538	566	317	14	5
2047	ITB	Auxiliary	Zone 5		4	4	4	150	7	14	6	6	5	0	0
2047	Tanker	Propulsion	Zone 5		91	84	91	2,931	136	488	209	220	93	5	2
2047	Tanker	Auxiliary	Zone 5		7	7	7	176	13	31	11	12	9	0	0
2047	Subtotal		Zone 5		382	352	382	16,383	618	1,716	764	805	423	19	7
2047	ITB	Propulsion	Zone 6										5,705	255	88
2047	ITB	Auxiliary	Zone 6										82	4	1
2047	Tanker	Propulsion	Zone 6										4,294	211	87
2047	Tanker	Auxiliary	Zone 6										408	17	5
2047	Subtotal (GHG Only)		Zone 6										10,489	487	181
2047	Annual Total				8,397	7,738	8,195	237,897	20,160	40,345	21,020	21,681	25,121	1,341	299

Vessel Activity and Assumed Engine Tiers									
Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	2015	Vessel Type	2047	%Baseline	
-	81	-	-	-	60.2	ITB	81.0	134.6%	
-	14	18	49	-	25.4	Tanker	81.0	318.9%	
					13,251,089	bbl	24,972,216	188.5%	

Notes:
 Tankers, Tugs, and ITBs adjusted for increase in vessels since baseline
 Tanks (withdrawal) and loading adjusted for increase in throughput since baseline. Loading assumed 20% of throughput.
 Tanker NOx adjusted for phase in of Tier 3 propulsion/auxiliary engines since baseline.
 Tugs adjusted for replacement with Tier 4 propulsion/Tier 3 auxiliary engines.
 Tankers propulsion and auxiliary engines in Zones 3 and 4 (<40 nm) calculated based on VSRP compliance rate during baseline period.

Table B1.46 Operational Emissions for 2047 (Mitigated)

Year	Source	Zone	Activity	Annual Emissions											
				PM10 (lb/yr)	PM2.5 (lb/yr)	DPM (lb/yr)	NOx (lb/yr)	SOx (lb/yr)	CO (lb/yr)	HC (lb/yr)	VOC (lb/yr)	CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)	
2047	ITB	Propulsion	Zone 1	Maneuver	43	40	43	2,021	71	182	83	87	49	2	1
2047	ITB	Boiler	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2047	ITB	Boiler	Zone 1	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2047	ITB	Auxiliary	Zone 1	Hotelling	138	128	138	5,213	245	479	213	224	158	7	2
2047	ITB	Auxiliary	Zone 1	Maneuver	11	11	11	431	20	40	18	19	13	1	0
2047	ITB	Pump	Zone 1	Hotelling	264	244	264	9,961	468	915	407	428	302	13	4
2047	ITB Tug	Propulsion	Zone 1	Maneuver	14	14	14	625	2	1,735	66	69	103	5	1
2047	ITB Tug	Auxiliary	Zone 1	Maneuver	12	11	12	92	0	41	18	19	14	1	0
2047	Tanker	Propulsion	Zone 1	Maneuver	74	68	74	1,974	66	546	324	342	45	3	3
2047	Tanker	Boiler	Zone 1	Hotelling	1,765	1,638	-	25,208	7,688	2,521	1,260	1,235	5,271	429	11
2047	Tanker	Boiler	Zone 1	Maneuver	11	10	-	161	49	16	8	8	34	3	0
2047	Tanker	Auxiliary	Zone 1	Hotelling	1,360	1,256	1,360	32,568	2,407	5,755	2,093	2,204	1,628	69	19
2047	Tanker	Auxiliary	Zone 1	Maneuver	44	40	44	1,054	77	185	67	71	52	2	1
2047	Tanker	Pump	Zone 1	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2047	Tanker Tugs	Propulsion	Zone 1	Maneuver	33	33	33	1,501	5	4,168	158	167	247	12	2
2047	Tanker Tugs	Auxiliary	Zone 1	Maneuver	29	27	29	221	1	99	44	47	33	1	0
2047	Tanker Tugs	Fugitives	Zone 1		-	-	-	-	-	-	1,663	1,663	-	-	-
2047	Tanks	Standing	Zone 1		-	-	-	-	-	-	4,065	4,065	-	-	-
2047	Tanks	Withdrawal	Zone 1		-	-	-	-	-	-	79	79	-	-	-
2047	Loading		Zone 1		37	37	-	1,695	609	424	1,922	1,922	737	1	0
2047	Loading	Auxiliary	Zone 1	Hotelling	139	96	2,071	2,513	394	288	163	252	152	10	1
2047	Loading	Mobile	Zone 1		5	3	5	219	-	27	7	7	26	-	-
2047	Loading	Fugitives	Zone 1		-	-	-	-	-	-	245	245	-	-	-
2047	Loading	Fugitives	Zone 1		-	-	-	-	-	-	-	-	-	-	-
2047	Subtotal		Zone 1		3,980	3,656	4,098	85,455	12,102	17,420	12,903	13,152	8,863	559	44
2047	ITB	Propulsion	Zone 2	Maneuver	186	172	186	8,737	308	788	358	377	211	9	3
2047	ITB	Boiler	Zone 2	Hotelling	-	-	-	-	-	-	-	-	-	-	-
2047	ITB	Boiler	Zone 2	Maneuver	-	-	-	-	-	-	-	-	-	-	-
2047	ITB	Auxiliary	Zone 2	Hotelling	88	81	88	3,323	156	305	136	143	101	4	1
2047	ITB	Auxiliary	Zone 2	Maneuver	7	7	7	270	13	25	11	12	8	0	0
2047	ITB Tug	Propulsion	Zone 2	Maneuver	8	8	8	363	1	1,007	38	40	60	3	0
2047	ITB Tug	Auxiliary	Zone 2	Maneuver	7	6	7	53	0	24	11	11	8	0	0
2047	ITB Tug	Propulsion	Zone 2	Maneuver	128	118	128	4,126	192	689	295	311	132	6	3
2047	Tanker	Boiler	Zone 2	Hotelling	320	297	-	4,569	1,393	457	228	224	955	78	2
2047	Tanker	Boiler	Zone 2	Maneuver	1	1	-	19	6	2	1	1	4	0	0
2047	Tanker	Auxiliary	Zone 2	Hotelling	978	903	978	23,387	1,731	4,138	1,505	1,585	1,171	49	14
2047	Tanker	Auxiliary	Zone 2	Maneuver	37	34	37	900	66	158	57	60	45	2	1
2047	Tanker Tugs	Propulsion	Zone 2	Maneuver	25	25	25	1,134	4	3,149	120	126	186	9	1
2047	Tanker Tugs	Auxiliary	Zone 2	Maneuver	22	20	22	167	1	75	33	35	25	1	0
2047	Subtotal		Zone 2		1,808	1,673	1,487	47,046	3,870	10,817	2,794	2,925	2,905	163	25
2047	ITB	Propulsion	Zone 3		580	535	580	27,211	959	2,453	1,115	1,174	657	29	10
2047	ITB	Auxiliary	Zone 3		13	12	13	489	23	45	20	21	15	1	0
2047	Tanker	Propulsion	Zone 3		400	369	400	24,633	600	2,153	923	972	411	20	8
2047	Tanker	Auxiliary	Zone 3		59	55	59	2,816	105	250	91	96	71	3	1
2047	Subtotal		Zone 3		1,052	971	1,052	55,149	1,686	4,901	2,149	2,263	1,153	53	19
2047	ITB	Propulsion	Zone 4		649	599	649	30,438	1,073	2,744	1,247	1,314	734	33	11
2047	ITB	Auxiliary	Zone 4		-	13	14	538	25	49	22	23	16	1	0
2047	Tanker	Propulsion	Zone 4		440	406	440	26,922	660	2,369	1,015	1,069	452	22	9
2047	Tanker	Auxiliary	Zone 4		58	53	58	2,722	103	245	89	94	69	3	1
2047	Subtotal		Zone 4		1,147	1,072	1,161	60,619	1,861	5,408	2,374	2,500	1,272	59	22
2047	ITB	Propulsion	Zone 5		280	258	280	13,127	463	1,184	538	566	317	14	5
2047	ITB	Auxiliary	Zone 5		4	4	4	150	7	14	6	6	5	0	0
2047	Tanker	Propulsion	Zone 5		91	84	91	2,931	136	488	209	220	93	5	2
2047	Tanker	Auxiliary	Zone 5		7	7	7	176	13	31	11	12	9	0	0
2047	Subtotal		Zone 5		382	352	382	16,383	618	1,716	764	805	423	19	7
2047	ITB	Propulsion	Zone 6		-	-	-	-	-	-	-	-	5,705	255	88
2047	ITB	Auxiliary	Zone 6		-	-	-	-	-	-	-	-	82	4	1
2047	Tanker	Propulsion	Zone 6		-	-	-	-	-	-	-	-	4,294	211	87
2047	Tanker	Auxiliary	Zone 6		-	-	-	-	-	-	-	-	408	17	5
2047	Subtotal (GHG Only)		Zone 6		-	-	-	-	-	-	-	-	10,489	487	181
2047	Annual Total				8,368	7,724	8,179	264,652	20,138	40,262	20,984	21,644	25,106	1,341	299

Table B1.47 Operational Greenhouse Gas Emissions Summary

Year	Basis	Source	Operational Emissions			Construction CO2e (MT/yr)	Total CO2e (MT/yr)	Increase CO2e (MT/yr)
			CO2 (MT/yr)	N2O (kg/yr)	CH4 (kg/yr)			
2011 - 2015		Ships Transit and Anchoring	8,471	397	133	8,580		
2011 - 2015		Ships Hotelling	2,506	171	14	2,552		
2011 - 2015		Tugs	289	12	3	293		
2011 - 2015		Loading	-	-	-	-		
2011 - 2015		Total	11,266	580	150	11,424	11,424	-
2019		Ships Transit and Anchoring	9,103	426	143	9,220		
2019		Ships Hotelling	2,669	182	15	2,718		
2019		Tugs	310	13	3	314		
2019		Loading	601	11	1	604		
2019		Total	12,684	632	162	12,856	94	12,950
2019	Mitigated	Ships Transit and Anchoring	9,098	426	143	9,214		
2019	Mitigated	Ships Hotelling	2,669	182	15	2,718		
2019	Mitigated	Tugs	310	13	3	314		
2019	Mitigated	Loading	601	11	1	604		
2019	Mitigated	Total	12,679	632	162	12,851	94	12,945
2031		Ships Transit and Anchoring	11,780	568	188	11,935		
2031		Ships Hotelling	5,361	377	26	5,462		
2031		Tugs	491	23	3	497		
2031		Loading	715	11	1	718		
2031		Total	18,347	980	218	18,612	94	18,706
2031	Mitigated	Ships Transit and Anchoring	11,768	568	187	11,924		
2031	Mitigated	Ships Hotelling	5,361	377	26	5,462		
2031	Mitigated	Tugs	491	23	3	497		
2031	Mitigated	Loading	739	12	1	742		
2031	Mitigated	Total	18,359	980	218	18,625	94	18,719
2047		Ships Transit and Anchoring	16,172	780	257	16,386		
2047		Ships Hotelling	7,360	518	36	7,498		
2047		Tugs	674	32	5	683		
2047		Loading	915	11	1	918		
2047		Total	25,121	1,341	299	25,485	94	25,579
2047	Mitigated	Ships Transit and Anchoring	16,156	779	257	16,370		
2047	Mitigated	Ships Hotelling	7,360	518	36	7,498		
2047	Mitigated	Tugs	674	32	5	683		
2047	Mitigated	Loading	915	11	1	918		
2047	Mitigated	Total	25,106	1,341	299	25,469	94	25,563

Notes:

MT = metric ton (1,000 kg)

CO2e calculated per Intergovernmental Panel on Climate Change (2015)

GWP of CO2 = 1, GWP of N2O = 265, GWP of CH4 = 28