

**Clipper Yacht Harbor
Marina Dock Replacement Project**

Initial Study / Mitigated Negative Declaration

**Appendix A
Criteria Air Pollutant and GHG Emissions Calculations**



City of Sausalito
420 Litho Street
Sausalito, CA 94965

May 2021

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310 Harbor Drive

Sausalito, CA

Criteria Air Pollutant and GHG Emissions Calculations

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December 2020

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Sheet 1: Emissions Summary

Table 1. 2022 Emissions (Lbs/yr)

Emissions Source	ROG	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
On-road Trips	27.9	63.7	79.1	0.1	0.6	0.3	15,134.3	1.1	2.6
Off-road Equipment	17.7	66.1	0.0	0.0	4.0	3.7	21,761.6	0.6	1.2
Water-based Equipment	158.5	1,413.8	933.5	1.2	75.2	73.4	173,014.7	802.7	1,736.2
Total	204.2	1,543.5	1,012.6	1.3	79.8	77.4	209,910.5	804.4	1,740.0

Table 2. 2023 Emissions (Lbs/yr)

Emissions Source	ROG	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
On-road Trips	23.3	57.8	69.3	0.1	0.5	0.3	13,691.7	0.9	2.3
Off-road Equipment	14.4	54.3	0.0	0.0	3.3	3.1	17,749.8	0.5	1.0
Water-based Equipment	135.0	1,208.6	798.5	1.0	64.2	62.5	149,239.6	800.6	1,735.6
Total	172.6	1,320.7	867.9	1.2	68.0	65.9	180,681.1	802.0	1,738.9

Table 3. 2022 Emissions (Average Lbs/Day)

Emissions Source	Average Lbs / Day ^(A)						MT			
	ROG	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O	CO2e
On-road Trips	0.3	0.6	0.7	0.0	0.0	0.0	6.9	0.0	0.0	7.2
Off-road Equipment	0.2	0.6	0.0	0.0	0.0	0.0	9.9	0.0	0.0	10.0
Water-based Equipment	1.4	12.9	8.5	0.0	0.7	0.7	78.5	0.4	0.8	322.3
Total	1.9	14.0	9.2	0.0	0.7	0.7	95.2	0.4	0.8	339.5

Note: (A) Assumes 22 construction days per month, with construction lasting from approximately 8/1 through the end of the year (i.e., 5 months or 110 days).

Table 4. 2023 Emissions (Average Lbs/Day)

Emissions Source	Average Lbs / Day ^(A)						MT			
	ROG	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O	CO2e
On-road Trips	0.2	0.5	0.6	0.0	0.0	0.0	6.2	0.0	0.0	6.5
Off-road Equipment	0.1	0.5	0.0	0.0	0.0	0.0	8.1	0.0	0.0	8.2
Water-based Equipment	1.2	11.0	7.3	0.0	0.6	0.6	67.7	0.4	0.8	311.4
Total	1.6	12.0	7.9	0.0	0.6	0.6	82.0	0.4	0.8	326.1

Note: (A) Assumes 22 construction days per month, with construction lasting from approximately 8/1 through the end of the year (i.e., 5 months or 110 days).

Sheet 2: Summary of Construction Activities

Table 1: Construction Activity Phasing Information and Descriptions

Location / Year	Phase / Activity Description	Total Construction Days	Description
Basin 3 (2022)	1.0 Mobilization	N/A	Water-based barge brought up from Southern California, and setup in San Francisco Bay Area. Workboat and land-based crane imported from Dixon, CA, and set up.
	1.1 Existing Dock Demolition and Off-haul	35	Deconstruction of existing dock in Basin 3 using hand tools, materials removed from water using land-based crane. Off-haul of materials to Dixon, CA for disposal.
	1.2 New Dock Assembly, Material Import, Pile Installation	120	Installation of piles using water-based barge powered by two workboats. Concurrent import and construction of the new dock in Basin 3.
	1.3 Final Dock Assembly, Utility Work, Inspections	50	Final construction of and placement of dock using hand tools and a workboat.
Basin 4 (2023)	2.1 Existing Dock Demolition and Off-haul	28	Deconstruction of existing dock in Basin 4 using hand tools, materials removed from water using land-based crane. Off-haul of materials to Dixon, CA for disposal.
	2.2 New Dock Assembly, Material Import, Pile Installation	100	Installation of piles using water-based barge powered by two workboats. Concurrent import and construction of the new dock in Basin 4.
	2.3 Final Dock Assembly, Utility Work, Inspections	40	Final construction of and placement of dock in Basin 4 using hand tools and a workboat.
	2.4 Demobilization	N/A	Breakdown of land-based crane, export back to Dixon, CA along with workboat.

Sheet 3: On-Road Hauling, Vendor, and Worker Trip Information

Table 1. Heavy-Heavy Duty Truck (HHDT) Trip Information (Hauling and Vendor Deliveries)

Location / Year	Phase	Reason for Trip	Type of Vehicle	Number of Vehicles	One-way Distance	Directional
Basin 3 (2022)	1.0	1.0.1 Bringing water-based crane (2) and sea skiffs (2) up from SoCal. Specific distance from Tracy to Sausalito.	HHDT	4	77.4	One-way
	1.0	1.0.2 Import land-based crane (2) and workboat (1) from Dixon, CA. Specific distance from Vacaville to Sausalito.	HHDT	3	58.4	Round-trip
	1.1	1.1.1 Export of debris to Dixon, CA for disposal. Return to the site for more debris. Specific distance from Vacaville to Sausalito.	HHDT	30	58.4	Round-trip
	1.2	1.2.1 Import dock material from Dixon, CA. Specific distance from Vacaville to Sausalito.	HHDT	35	58.4	Round-trip
Basin 4 (2023)	2.1	2.1.1 Export of debris to Dixon, CA for disposal. Return to the site for more debris. Specific distance from Vacaville to Sausalito.	HHDT	30	58.4	Round-trip
	2.2	2.2.1 Import dock material from Dixon, CA. Specific distance from Vacaville to Sausalito.	HHDT	30	58.4	Round-trip
	2.4	2.4.1 Export land-based crane and workboats to Dixon, CA. Specific distance from Sausalito to Vacaville.	HHDT	4	58.4	Round-trip

Table 2. Light Duty Auto (LDA) and Light Duty Truck (LDT) Trip Information (Flagger Trucks and Worker Trips)

Location / Year	Phase	Reason for Trip	Type of Vehicle	Days	Number of Vehicles	One-way Distance	Directional
Basin 3 (2022)	1.0	1.0.1 Flagger trucks. Bringing water-based crane up from SoCal. Specific distance from Tracy to Sausalito.	LDT2	N/A	2	77.4	One-way
	1.0	1.0.2 Flagger trucks. Import land-based crane and workboats from Dixon, CA	LDT2	N/A	6	58.4	Round-trip
	1.1	1.2-3.1 Worker Trips	LDA/LDT1/LDT 2	35	5	14.7	Round-trip
	1.2			120			
1.3	50						
Basin 4 (2023)	2.1	2.1-3.1 Worker Trips	LDA/LDT1/LDT 2	28	5	14.7	Round-trip
	2.2			100			
	2.3			40			
	2.4	2.4.1 Flagger trucks. Export land-based crane and workboats to Dixon, CA. Specific distance from Sausalito to Vacaville.	LDT2	N/A	6	58.4	Round-trip

Sheet 4: Heavy-Duty Off-Road Equipment Operating Information

Table 1. Heavy-Duty, Off-Road, On-Land Construction Equipment Information

Location / Year	Phase	Off-road Equipment	Total Construction Days Used	Horsepower	Daily Runtime
Basin 3 (2022)	1.1	Land-based Crane (Tier 4)	35	485	7
	1.2	Forklift	120	130	7
Basin 4 (2023)	2.1	Land-based Crane (Tier 4)	28	485	7
	2.2	Forklift	100	130	7

Sheet 5: Watercraft Equipment Information

Table 1: Watercraft Equipment Information

Location / Year	Phase	Water-based Craft	Total Construction Days	Quantity	Horsepower	Daily Runtime
Basin 3 (2022)	1.1	Workboat	35	1	60	7
	1.2	Sea Skiff	120	2	60	2
	1.2	Barge - Generator	120	1	220	6
	1.2	Diesel Impact Hammer	120	1	N/A	6
	1.2 / 1.3	Workboat	120	1	60	7
Basin 4 (2023)	2.1	Workboat	28	1	60	7
	2.2	Sea Skiff	100	2	60	2
	2.2	Barge - Generator	100	1	220	6
	1.2	Diesel Impact Hammer	100	1	N/A	6
	2.2 / 2.3	Workboat	100	1	60	7

Sheet 6: Off-Site, On-Road, Mobile Source Emissions

Table 1. Heavy-Heavy Duty Truck (HHDT) Trip Details and Runtime (Hauling and Vendor Deliveries)

Location / Year	Phase	Reason for Trip	Type of Vehicle	Number of Vehicles	One-way Distance	Directional	Number of Trips	VMT
Basin 3 (2022)	1.0	1.0.1	HHDT	4	77.4	One-way	4	310
	1.0	1.0.2	HHDT	3	58.4	Round-trip	6	350
	1.1	1.1.1	HHDT	30	58.4	Round-trip	60	3,504
	1.2	1.2.1	HHDT	35	58.4	Round-trip	70	4,088
Basin 4 (2023)	2.1	2.1.1	HHDT	30	58.4	Round-trip	60	3,504
	2.2	2.2.1	HHDT	30	58.4	Round-trip	60	3,504
	2.4	2.4.1	HHDT	4	58.4	Round-trip	8	467
2022 Sum for HHDT							140	8,252
2023 Sum for HHDT							128	7,475

Table 2. Heavy-Heavy Duty Truck (HHDT) Emission Factors

Type of Rate	HHDT Emissions Rate (Diesel)								
	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
Lbs/Mile	0.0016028	3.124E-05	5.99E-05	0.6752035	1.752E-06	0.0001061	3.772E-05	0.0001658	6.379E-06
Lbs/Trip	0.3365043	0.0001812	0.0001894	60.784891	0.0011141	0.0095545	0.0239861	0.3268318	0.0005743

Table 3. 2022 HHDT Emissions (Lbs/yr)

Emissions Source	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
VMT	13.23	0.26	0.49	5571.78	0.01	0.88	0.31	1.37	0.05
Trip	47.11	0.03	0.03	8509.88	0.16	1.34	3.36	45.76	0.08
Total	60.34	0.28	0.52	14081.66	0.17	2.21	3.67	47.12	0.13

Table 4. 2023 HHDT Emissions (Lbs/yr)

Emissions Source	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
VMT	11.98	0.23	0.45	5047.28	0.01	0.79	0.28	1.24	0.05
Trip	43.07	0.02	0.02	7780.47	0.14	1.22	3.07	41.83	0.07
Total	55.05	0.26	0.47	12827.75	0.16	2.02	3.35	43.07	0.12

Table 5. Light Duty Auto (LDA) and Light Duty Truck (LDT) Trip Details (Flagger Trucks and Worker Trips)

Location / Year	Phase	Reason for Trip	Type of Vehicle	Days	Number of Vehicles	One-way Distance	Directional	Number of Trips	VMT
Basin 3 (2022)	1.0	1.0.1	LDT2	N/A	2	77.4	One-way	2	155
	1.0	1.0.2	LDT2	N/A	6	58.4	Round-trip	12	701
	1.1	1.2-3.1	LDA/LDT1/LDT2	35	5	14.7	Round-trip	350	5,145
	1.2			1,200				17,640	
	1.3			500				7,350	
Basin 4 (2023)	2.1	2.1-3.1	LDA/LDT1/LDT2	28	5	14.7	Round-trip	280	4,116
	2.2			1,000				14,700	
	2.3			400				5,880	
	2.4	2.4.1	LDT2	N/A	6	58.4	Round-trip	12	701
2022 Sum for LDA / LDT								1,680	30,991
2023 Sum for LDA / LDT								1,412	25,397

Table 6. Light Duty Auto (LDA) and Light Duty Truck (LDT) Emission Factors

Type of Rate	Emissions Rates								
	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
LDA (Gasoline)									
Lbs/Mile	8.31E-07	3.969E-07	9.607E-07	0.005446	5.075E-08	9.408E-08	1.97E-07	1.313E-05	5.389E-08
Lbs/Trip	3.22E-05	2.797E-07	3.042E-07	0.0088224	8.852E-06	4.275E-06	0.0001549	0.0003766	8.73E-08
LDT1 (Gasoline)									
Lbs/Mile	0.000391	3.371E-06	3.666E-06	0.0965348	0.0001089	4.376E-05	0.0029209	0.0037364	9.553E-07
Lbs/Trip	0.000391	3.371E-06	3.666E-06	0.0965348	0.0001089	4.376E-05	0.0029209	0.0037364	9.553E-07
LDT2 (Gasoline)									
Lbs/Mile	4.604E-06	1.187E-06	2.873E-06	0.0204923	2.217E-07	3.927E-07	8.945E-07	5.104E-05	2.028E-07
Lbs/Trip	0.0001367	7.759E-07	8.438E-07	0.0324205	3.313E-05	1.526E-05	0.0006596	0.0013461	3.208E-07

Table 7. 2022 LDA/LDT1/LDT2 Emissions (Lbs/yr)^(A)

Emissions Source	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
VMT	3.1	0.0	0.1	991.1	0.8	0.3	22.6	29.5	0.0
Trip	0.2	0.0	0.0	61.6	0.1	0.0	1.6	2.5	0.0
Total	3.3	0.0	0.1	1,052.6	0.9	0.4	24.3	32.0	0.0

Notes: (A) Assumes 50% of trips are LDA, 25% are LDT1, and 25% are LDT2, consistent with CalEEMod assumptions (CAPCOA 2017).

Table 8. 2023 LDA/LDT1/LDT2 Emissions (Lbs/yr)^(A)

Emissions Source	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
VMT	2.5	0.0	0.1	812.2	0.7	0.3	18.6	24.2	0.0
Trip	0.2	0.0	0.0	51.7	0.1	0.0	1.4	2.1	0.0
Total	2.7	0.0	0.1	863.9	0.8	0.3	19.9	26.3	0.0

Notes: (A) Assumes 50% of trips are LDA, 25% are LDT1, and 25% are LDT2, consistent with CalEEMod assumptions (CAPCOA 2017).

Table 9. 2022 Mobile Source Emissions Summary (Lbs/yr)

Emissions Source	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
HHDT	60.3	0.3	0.5	14081.7	0.2	2.2	3.7	47.1	0.1
LDA/LDT	3.3	0.0	0.1	1052.6	0.9	0.4	24.3	32.0	0.0
Total	63.7	0.3	0.6	15134.3	1.1	2.6	27.9	79.1	0.1

Table 10. 2023 Mobile Source Emissions Summary (Lbs/yr)

Emissions Source	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
HHDT	55.1	0.3	0.5	12827.7	0.2	2.0	3.4	43.1	0.1
LDA/LDT	2.7	0.0	0.1	863.9	0.8	0.3	19.9	26.3	0.0
Total	57.8	0.3	0.5	13691.7	0.9	2.3	23.3	69.3	0.1

Sheet 7: Heavy-Duty, Off-Road Equipment Emissions

Table 1. Heavy-Duty, Off-Road, On-Land Construction Equipment Details and Runtime

Location / Year	Phase	Off-road Equipment	Total Construction Days Used	Horsepower	Daily Runtime	Load Factor	Annual Runtime (hp-hr)	Gallons
Basin 3 (2022)	1.1	Land-based Crane (Tier 4)	35	485	7	0.29	34,459	513
	1.2	Forklift	120	130	7	0.20	21,840	454
Basin 4 (2023)	2.1	Land-based Crane (Tier 4)	28	485	7	0.29	27,567	410
	2.2	Forklift	100	130	7	0.20	18,200	378

Notes: Load factor obtained from CalEEMod (v. 2016.3.2) technical appendix.

Table 2. Heavy-Duty, Off-Road Equipment Emission Rates

Type of Equipment and Horsepower Bin	Operation Rate (lbs/hp-hr)								
	NOx	PM2.5	PM10	CO2	CH4 ^(A)	N2O ^(A)	ROG	CO	SOx
Forklift (100-174 hp)	0.001982038	0.000121725	0.00013231	0.467783133	0.000573	0.001257	0.000573	0.001257	0.000223
Crane (T4 Final; 300-599 hp)	0.000661387	3.04238E-05	3.30693E-05	0.335038341	0.000573	0.001257	0.000573	0.001257	0.000373

Note: (A) CH4 and N2O emfac derived from U.S. EPA "Emission Factors for GHG Inventories"; based on emissions per gallon consumed

Table 3. 2022 Off-Road Emissions (Lbs / Yr)

Equipment	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
Land-based Crane (Tier 4)	22.8	1.0	1.1	11545.2	0.3	0.6	19.8	43.3	12.9
Forklift	43.3	2.7	2.9	10216.4	0.3	0.6	12.5	27.4	4.9
Total	66.1	3.7	4.0	21,761.6	0.6	1.2	32.3	70.7	17.7

Table 4. 2023 Off-Road Emissions (Lbs / Yr)

Equipment	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
Land-based Crane (Tier 4)	18.2	0.8	0.9	9236.1	0.2	0.5	15.8	34.6	10.3
Forklift	36.1	2.2	2.4	8513.7	0.2	0.5	10.4	22.9	4.1
Total	54.3	3.1	3.3	17,749.8	0.5	1.0	26.2	57.5	14.4

Sheet 8: Watercraft Emissions

Table 1. Watercraft Construction Equipment Details and Runtime

Location / Year	Phase	Water-based Craft	Total Construction Days	Quantity	Horsepower	Daily Runtime	Load Factor	Annual Runtime (hp-hrs) ^(A)
Basin 3 (2022)	1.1	Workboat	35	1	60	7	0.45	6,615
	1.2	Sea Skiff	120	2	60	2	0.45	12,960
	1.2	Barge - Generator	120	1	220	6	0.43	68,112
	1.2	Diesel Impact Hammer (DIH)	120	1	N/A	6	N/A	720
	1.2 / 1.3	Workboat	120	1	60	7	0.45	22,680
Basin 4 (2023)	2.1	Workboat	28	1	60	7	0.45	5,292
	2.2	Sea Skiff	100	2	60	2	0.45	10,800
	2.2	Barge - Generator	100	1	220	6	0.43	56,760
	2.2	Diesel Impact Hammer (DIH)	100	1	N/A	6	N/A	600
	2.2 / 2.3	Workboat	100	1	60	7	0.45	18,900
2022 Workboat / Sea Skiff Total								42,975
2022 Barge Generator Total								68,112
Diesel Impact Hammer Runtime Total								720
2023 Workboat / Sea Skiff Total								35,592
2023 Barge Generator Total								56,760
Diesel Impact Hammer Runtime Total								600

Note: (A) Rate is hours of runtime for Diesel Impact Hammer

Table 2. Watercraft Emission Rates

Equipment	Operation Rate (lbs/hp-hr) ^(A)								
	NOX	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SO2
Workboat / Skiff	0.01611552	0.000771605	0.000795855	1.294091711	0.000163139	4.4092E-05	0.00180776	0.00676808	
Barge - Generator	0.007597	0.000454145	0.000454145	1.252709436	7.93651E-05	2.425E-05	0.000892857	0.00748677	1.3228E-05
DIH	0.14294264	0.006500826	0.007066115	22.50037848	0.554370837	1.21535145	0.014009501	0.09308143	0.00020768

Note: Emission Rate for Diesel Impact Hammer is lbs/gal

Table 3. 2022 Watercraft Emissions (Lbs / Yr)

Equipment	NOX	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SO2
Workboat / Skiff	692.6	33.2	34.2	55613.6	7.0	1.9	77.7	290.9	0.0
Barge - Generator	517.4	30.9	30.9	85324.5	5.4	1.7	60.8	509.9	0.9
DIH	203.8	9.3	10.1	32076.5	790.3	1732.6	20.0	132.7	0.3
Total	1,413.8	73.4	75.2	173,014.7	802.7	1,736.2	158.5	933.5	1.2

Table 4. 2023 Watercraft Emissions (Lbs / Yr)

Equipment	NOX	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SO2
Workboat / Skiff	573.6	27.5	28.3	46059.3	5.8	1.6	64.3	240.9	0.0
Barge - Generator	431.2	25.8	25.8	71103.8	4.5	1.4	50.7	424.9	0.8
DIH	203.8	9.3	10.1	32076.5	790.3	1732.6	20.0	132.7	0.3
Total	1,208.6	62.5	64.2	149,239.6	800.6	1,735.6	135.0	798.5	1.0

Sheet 9: Summary of Emissions Rates

Table 1. On-Road Mobile Sources (Operational Rates)

Vehicle Classification	Operation Rate (lbs/mi)								
	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
HHDT (Diesel)	0.001603	3.12E-05	5.99E-05	0.675204	1.75E-06	0.000106	3.77E-05	0.000166	6.38E-06
LDA (Gasoline)	8.31E-07	3.97E-07	9.61E-07	0.005446	5.08E-08	9.41E-08	1.97E-07	1.31E-05	5.39E-08
LDT1 (Gasoline)	0.000391	3.37E-06	3.67E-06	0.096535	0.000109	4.38E-05	0.002921	0.003736	9.55E-07
LDT2 (Gasoline)	4.6E-06	1.19E-06	2.87E-06	0.020492	2.22E-07	3.93E-07	8.94E-07	5.1E-05	2.03E-07

Source: EMFAC2017 (v1.0.3; Air District: BAAQMD)

Table 2. On-Road Mobile Sources (Trip Rates)

Vehicle Classification	Trip Rate (lbs/trip)								
	NOx	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SOx
HHDT (Diesel)	0.336504	0.000181	0.000189	60.78489	0.001114	0.009555	0.023986	0.326832	0.000574
LDA (Gasoline)	3.22E-05	2.8E-07	3.04E-07	0.008822	8.85E-06	4.28E-06	0.000155	0.000377	8.73E-08
LDT1 (Gasoline)	0.000391	3.37E-06	3.67E-06	0.096535	0.000109	4.38E-05	0.002921	0.003736	9.55E-07
LDT2 (Gasoline)	0.000137	7.76E-07	8.44E-07	0.03242	3.31E-05	1.53E-05	0.00066	0.001346	3.21E-07

Source: EMFAC2017 (v1.0.3; Air District: BAAQMD)

Table 3. Off-road Equipment Emission Rates

Equipment	Operation Rate (lbs/hp-hr)									
	NOx	PM2.5	PM10	CO2	CH4 ^(A)	N2O ^(A)	ROG	CO	SOx	gal/hp-hr
Forklift (100-174 hp)	0.001982	0.000122	0.000132	0.467783	0.000573	0.001257	0.000223	0.002661	4.32E-06	0.02079
Crane (T4 Final; 300≤hp<600)	0.000661	3.04E-05	3.31E-05	0.335038	0.000573	0.001257	0.000373	0.00485	3.09E-06	0.01489

Source: OFFROAD2017 (v1.0.1; ORION) and CARB2017;

(A) CH4 and N2O emfac derived from U.S. EPA "Emission Factors for GHG Inventories"; based on emissions per gallon

Table 4. Off-road Equipment Emission Rates

Equipment	Operation Rate (lbs/gal)									
	NOx	PM2.5	PM10	CO2	CH4 ^(A)	N2O ^(A)	ROG	CO	SOx	Gal/HR
Diesel Impact Hammer	0.142943	0.006501	0.007066	22.50038	0.554371	1.215351	0.01401	0.093081	0.000208	1.98

Source: OFFROAD2017 (v1.0.1; ORION);

(A) CH4 and N2O emfac derived from U.S. EPA "Emission Factors for GHG Inventories"; based on emissions per gallon

Table 5. Marine Vessel Emission Rates

Marine Equipment	Operation Rate (lbs/hp-hr)								
	NOX	PM2.5	PM10	CO2	CH4	N2O	ROG	CO	SO2
Workboat	0.016116	0.000772	0.000796	1.294092	0.000163	4.41E-05	0.001808	0.006768	
Sea Skiff	0.016116	0.000772	0.000796	1.294092	0.000163	4.41E-05	0.001808	0.006768	
Barge - Generator	0.007597	0.000454	0.000454	1.252709	7.94E-05	2.43E-05	0.000893	0.007487	1.32E-05

Source: https://www.portoakland.com/files/PDF/Port_Oakland_2017_Emissions_Inventory.pdf (Section 3.1.3.1 ; Dredgers and Support Vessels; "Becky T")