Table 11: Standards for Outboard and Personal Watercraft Spark-Ignition Marine Engines

Model Year	HC+NOx (g/kW-hr)	
	<4.3 kW	>4.3 kW[a]
1998	278	$0.917x(151 + 557/P^{0.9})+2.44$
1999	253	$0.833x(151 + 557/P^{0.9})+2.89$
2000	228	$0.750x(151 + 557/P^{0.9})+3.33$
2001	204	$0.667x(151 + 557/P^{0.9})+3.78$
2002	179	$0.583x(151 + 557/P^{0.9})+4.22$
2003	155	$0.500x(151 + 557/P^{0.9})+4.67$
2004	130	$0.417x(151 + 557/P^{0.9})+5.11$
2005	105	$0.333x(151 + 557/P^{0.9})+5.56$
2006	81	$0.250x(151 + 557/P^{0.9})+6.00$

[a] For engines over 4.3 kW, the emission standard is a function of rated engine power (P), in Kilowatts.

Table 12: Standards for Spark-Ignition Marine Generators ≤19kW

Phase	Class	Total Displacement (cubic centimeters)	Model Year	HC+NOx (g/kW-hr)	CO (g/kW-hr)
Phase 1 [a]	I	cc <225	1997	16.1	519
	II	cc ≥225	1997	13.4	519
Phase 2	I-A	cc <66	2001	50	610
	I-B	66≤ cc <100	2001	40	610
	I	100≤ cc <225	August 2007 [b]	16.1	610
	II	cc ≥0.225	2001 2002 2003 2004 2005	18.0 16.6 15.0 13.6 12.1	610

[a] Zero hour standards (no deterioration considered in standards).
[b] Effective date. (If a new engine family is introduced after August 1, 2003, it must meet the Phase 2 standards.)

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Tier	Model Year	HC+NOx (g/kW-hr)	CO (g/kW-hr)
1	2004	4.0	50
2[a]	2007	2.7	4.4

Table 13: Standards for Spark-Ignition Marine Generators >19kW

[a] Alternatively, can meet standard of (HC+NOx) × $CO^{0.784}$ ≤8.57 g/kW-hr.

How can I get more information?

You can access documents on marine engine emission standards from EPA's main non-road engines, equipment, and vehicles Web page at:

www.epa.gov/nonroad

You can also contact the OTAQ library for document information at:

U.S. Environmental Protection Agency
Office of Transportation and Air Quality Library
2000 Traverwood Drive
Ann Arbor, MI 48105
(734) 214-4311 & 214-4434
E-mail: Group_AALibrary@epa.gov

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Appendix 3 – Corrected Calculation Worksheets

10-61

Table D1. Emissions Summary

Scenario	Annual Emissions (tons per year)					Metric Tons
	NOx	PM	ROG	CO	CO2	CO2
Existing						
Hanson (TS&G)	43.9	1.5	3.8	12.1	2,823.1	
Hanson (DS-10)	33.6	1.3	3.4	10.7	2,684.4	
Suisin Assoc. (TS&G)	1.8	0.1	0.2	0.5	113.7	
Suisun Assoc. (DS-10)	0.7	0.0	0.1	0.2	52.8	
Suisun Assoc. (Jerico)	0.4	0.0	0.1	0.2	39.8	
Jerico	0.6	0.0	0.1	0.3	60.6	
TOTAL	*81.0*	*3.0*	*7.6*	*24.0*	*5,774.4*	*5,238*
Future (2010)						
Hanson (TS&G)	64.1	2.2	5.6	17.6	4,115.7	
Hanson (DS-10)	48.9	1.9	4.9	15.6	3,913.5	
Suisin Assoc. (TS&G)	6.1	0.2	0.5	1.7	393.0	
Suisun Assoc. (DS-10)	2.2	0.1	0.2	0.7	177.7	
Suisun Assoc. (Jerico)	1.5	0.1	0.2	0.7	142.0	
Jerico	0.6	0.0	0.1	0.3	60.6	
TOTAL	123.5	4.5	11.6	36.6	8,802.4	*7,985*
Change from Existing	***42.5***	*1.6*	*4.0*	*12.6*	*3,028.1*	*2,747*
Future (2011) NOx Emissions						
Hanson (TS&G)	45.5	--	--	--	--	
Hanson (DS-10)	45.3	--	--	--	--	
Suisin Assoc. (TS&G)	4.3	--	--	--	--	
Suisun Assoc. (DS-10)	2.1	--	--	--	--	
Suisun Assoc. (Jerico)	1.5	--	--	--	--	
Jerico	0.6	--	--	--	--	
TOTAL	*99.4*	--	--	--	--	
Change from existing	***18.4***	--	--	--	--	-
Future (2018) NOx Emissions						
Hanson (TS&G)	40.7	--	--	--	--	
Hanson (DS-10)	42.2	--	--	--	--	
Suisin Assoc. (TS&G)	3.9	--	--	--	--	
Suisun Assoc. (DS-10)	1.9	--	--	--	--	
Suisun Assoc. (Jerico)	1.3	--	--	--	--	
Jerico	0.6	--	--	--	--	
TOTAL	*90.5*	--	--	--	--	
Change from Existing	*9.5*	--	--	--	--	-

10-61 cont.

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Table D1A. Emissions Summary - Corrected

Scenario	Annual Emissions (tons per year)					Metric Tons
	NOx	PM	ROG	CO	CO2	CO2
Existing						
Hanson (TS&G)	43.9	1.5	3.8	12.1	2736.4	
Hanson (DS-10)	33.6	1.3	3.4	10.7	2602.0	
Suisin Assoc. (TS&G)	1.8	0.1	0.2	0.5	110.3	
Suisun Assoc. (DS-10)	0.7	0.0	0.1	0.2	51.2	
Suisun Assoc. (Jerico)	0.4	0.0	0.1	0.2	39.3	
Jerico	0.6	0.0	0.1	0.3	60.6	
TOTAL	*81.0*	*3.0*	*7.6*	*24.0*	*5,599.7*	*5,080*
Future (2010)						
Hanson (TS&G)	64.1	2.2	5.6	17.6	3989.3	
Hanson (DS-10)	48.9	1.9	4.9	15.6	3793.4	
Suisin Assoc. (TS&G)	6.1	0.2	0.5	1.7	380.9	
Suisun Assoc. (DS-10)	2.2	0.1	0.2	0.7	172.3	
Suisun Assoc. (Jerico)	1.4	0.1	0.2	0.7	140.3	
Jerico	0.6	0.0	0.1	0.3	60.6	
TOTAL	123.4	4.5	11.6	36.6	8,536.7	*7,744*
Change from Existing	*42.5*	*1.6*	*4.0*	*12.6*	*2,937.0*	*2,664*
Future (2011) NOx Emissions						
Hanson (TS&G)	42.9					
Hanson (DS-10)	44.5					
Suisin Assoc. (TS&G)	4.1					
Suisun Assoc. (DS-10)	2.0					
Suisun Assoc. (Jerico)	1.4					
Jerico	0.6					
TOTAL	*95.5*					
Change from existing	*14.5*					-
Future (2018) NOx Emissions						
Hanson (TS&G)	35.1	--	--	--	--	
Hanson (DS-10)	33.8	--	--	--	--	
Suisin Assoc. (TS&G)	3.4	--	--	--	--	
Suisun Assoc. (DS-10)	1.5	--	--	--	--	
Suisun Assoc. (Jerico)	1.2	--	--	--	--	
Jerico	0.5	--	--	--	--	
TOTAL	*75.5*	--	--	--	--	
Change from Existing	*-5.5*	--	--	--	--	-

10-61 cont.

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Table D2. Mining Events (Current and Requested)

Parcel	Current Conditions - Permitted		Requested Conditions	
	Annual Volume	Mining Events [a]	Annual Volume	Mining Events [a]
State Lands Commission Parcels				
PRC 709.1 Presidio Shoals (Hanson)	205,366	103	340,000	170
PRC 2036.1 Point Knox South (Hanson)	254,626	127	450,000	225
PRC 7779.1 Point Knox Shoal (Hanson)	396,656	198	550,000	275
PRC 7780.1 Alcatraz South Shoal (Hanson)	108,318	54	200,000	100
PRC 7781.1: Suisun Associates	85,407	43	300,000	150
State Lands Lease Totals	*1,050,373*	*525*	*1,840,000*	*920*
Private Parcels				
Grossi Middle Ground: ACOE Permit No. 25653N (Hanson)	64,981	32	25,000	13
Grossi Middle Ground: ACOE Permit No. 24996N (Hanson)	64,982	32	25,000	13
Grossi Middle Ground: ACOE Permit No. 24913N (Jerico)	64,982	32	150,000	75
Private Parcel Lease Totals	*194,945*	*96*	*200,000*	*101*
Total All Leases	**1,245,318**	**621**	**2,040,000**	**1,021**
Net Change in Mining Events	**400**			

[a] Assumes that 2,000 cubic yards of sand are collected during each mining event

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Table D3. Emission Factors for Mining Equipment (Baseline)

Equipment Name	Type	Manufacture Year [a]	Horsepower [a]	Load Factor [b]	Emission Factor (g/bhp-hr) [c,d]					Emission Rate (lb/hr)				
					NOx	PM	ROG	CO	CO2	NOx	PM	ROG	CO	CO2
Hanson American River	Tug (2 engines)	2003	1,710	0.5	6.93	0.29	0.68	1.97	586.3	13.1	0.5	1.3	3.7	1,105.2
Hanson San Joaquin River	Tug (2 engines)	2001	2,600	0.5	6.93	0.29	0.68	1.97	586.3	19.9	0.8	1.9	5.6	1,680.4
	Barge - Main Engine	1983	1,000	0.52	13.17	0.36	0.95	3.07	586.3	15.1	0.4	1.1	3.5	672.1
	Barge - Generator (Aux)	1984	265	0.43	10.23	0.32	1.07	4.33	586.3	2.6	0.1	0.3	1.1	147.3
Hanson TS & G	Barge - Thruster (Aux)	1984	304	0.43	10.23	0.32	1.07	4.33	586.3	2.9	0.1	0.3	1.2	169.0
	Barge - Main Engine	2001	1,100	0.52	6.93	0.29	0.68	1.97	586.3	8.7	0.4	0.9	2.5	739.4
	Barge - Monitor Pump (Aux)	2002	440	0.43	6.93	0.26	0.81	2.78	586.3	2.9	0.1	0.3	1.2	244.6
	Barge - Flood Pump (Aux)	2002	440	0.43	6.93	0.26	0.81	2.78	586.3	2.9	0.1	0.3	1.2	244.6
Hanson DS-10	Barge - Generator (Aux)	1984	375	0.43	10.23	0.32	1.07	4.33	586.3	3.6	0.1	0.4	1.5	208.4
	Tug (2 engines)	2001	1,060	0.5	6.93	0.29	0.68	1.97	586.3	8.1	0.3	0.8	2.3	685.1
Jerico Tug	Tug (generator)	2000	64	0.31	6.93	0.46	1.18	3.59	586.3	0.3	0.0	0.1	0.2	25.6
	Barge Generator (Aux)	2004	99	0.43	6.93	0.46	1.18	3.59	586.3	0.7	0.0	0.1	0.3	55.0
Jerico Barge	Barge Pump (Aux)	2001	230	0.43	6.93	0.26	0.81	2.78	586.3	1.5	0.1	0.2	0.6	127.8
Jerico Loader	Loader	2007	195	0.43	4.83	0.12	0.81	3.73	586.3	0.9	0.0	0.1	0.7	108.4

[a] Provided by Project Applicants.

[b] Based on information provided in Appendix B - Emissions Estimation Methodology for Commercial Harbor Craft Operating in California, from CARB's *Technical Support Document: Initial Statement of Reason for Proposed Rule Making, Proposed Regulation for Commercial Harbor Craft*, September 2007.

[c] Criteria pollutant emission factors obtained from Appendix B (cited above). All Equipment except for the TS&G assumes a fuel correction factor of 0.948 and 0.8 for NOx and PM respectively while the TS&G assumes a fuel correction factor of 0.930 and 0.720 for NOx and PM10 respectively.

[d] CO2 emission factors derived from OFFROAD2007. Represents CO2 emission factors for diesel fueled engines.

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Table D3A. Emission Factors for Mining Equipment (Baseline) - Corrected

Equipment Name	Type	Manufacture Year [a]	Horsepower [a]	Load Factor [b]	Emission Factor (g/bhp-hr) [c,d]					Emission Rate (lb/hr)				
					NOx[2]	PM	ROG	CO	CO2[1]	NOx	PM	ROG	CO	CO2
Hanson American River	Tug (2 engines)	2003	1,710	0.5	6.93	0.29	0.68	1.97	568.3	13.1	0.5	1.3	3.7	1,071.2
Hanson San Joaquin River	Tug (2 engines)	2001	2,600	0.5	6.93	0.29	0.68	1.97	568.3	19.9	0.8	1.9	5.6	1,628.8
	Barge - Main Engine	1983	1,000	0.52	13.17	0.36	0.95	3.07	568.3	15.1	0.4	1.1	3.5	651.5
	Barge - Generator (Aux)	1984	265	0.43	10.23	0.32	1.07	4.33	568.3	2.6	0.1	0.3	1.1	142.8
Hanson TS & G	Barge - Thruster (Aux)	1984	304	0.43	10.23	0.32	1.07	4.33	568.3	2.9	0.1	0.3	1.2	163.8
	Barge - Main Engine	2001	1,100	0.52	6.93	0.29	0.68	1.97	568.3	8.7	0.4	0.9	2.5	716.7
	Barge - Monitor Pump (Aux)	2002	440	0.43	6.93	0.26	0.81	2.78	568.3	2.9	0.1	0.3	1.2	237.0
	Barge - Flood Pump (Aux)	2002	440	0.43	6.93	0.26	0.81	2.78	568.3	2.9	0.1	0.3	1.2	237.0
Hanson DS-10	Barge - Generator (Aux)	1984	375	0.43	10.23	0.32	1.07	4.33	568.3	3.6	0.1	0.4	1.5	202.0
	Tug (2 engines)	2001	1,060	0.5	6.93	0.29	0.68	1.97	568.3	8.1	0.3	0.8	2.3	664.0
Jerico Tug	Tug (generator)	2000	64	0.31	6.93	0.46	1.18	3.59	568.3	0.3	0.0	0.1	0.2	24.9
	Barge Generator (Aux)[3]	2004	99	0.43	4.62	0.46	1.18	3.59	568.3	0.4	0.0	0.1	0.3	53.3
Jerico Barge	Barge Pump (Aux)	2001	230	0.43	6.93	0.26	0.81	2.78	568.3	1.5	0.1	0.2	0.6	123.9
Jerico Loader	Loader	2007	195	0.43	4.83	0.12	0.81	3.73	568.3	0.9	0.0	0.1	0.7	105.1

[a] Provided by Project Applicants.

[b] Based on information provided in Appendix B - Emissions Estimation Methodology for Commercial Harbor Craft Operating in California, from CARB's *Technical Support Document: Initial Statement of Reason for Proposed Rule Making, Proposed Regulation for Commercial*

[c] Criteria pollutant emission factors obtained from Appendix B (cited above). All Equipment except for the TS&G assumes a fuel correction factor of 0.948 and 0.8 for NOx and PM respectively while the TS&G assumes a fuel correction factor of 0.930 and 0.720 for NOx and PM10

[d] CO2 emission factors derived from OFFROAD2007. Represents CO2 emission factors for diesel fueled engines.

[1] Correction noted in TRC Comment: *2. CO2 Emission Factor Accuracy*

[2] Correction noted in TRC Comment: *3. NOx Tier II Emission Factor Accuracy*

[3] Correction noted in TRC Comment: *6. Jerico Dredge Barge Generator NOx Emission Factor*