Appendix D Air Emissions Calculations

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Table 1 EA-18 G (F414-GE-400 Engines) Emission Factors

Flight Operation	Fuel used (lbs)	Emissions from Single Flight Operation[1,2] (lb/op)					
		CO	NO_x	HC	SO_2[3]	PM_{10}	CO_2
Straight-In Arrival LTO	2612	265.30	31.08	69.70	5.30	18.21	7823.99
Break Arrival LTO	2528	266.46	31.15	70.27	5.15	17.54	7553.13
Touch-and-Go/FCLP	706	0.50	14.47	0.08	1.43	3.95	2249.53
Depart&Reenter/ GCA Box (GCA Pattern)	1411	1.01	28.95	0.17	2.86	7.89	4499.05

Notes:

[1] Fuel used and emission factors for "Departure" and "Straight-In Arrival" from AESO Memorandum Report No. 9815, Rev G, March 2011.

[2] Emission factors for "Touch-and-Go" and "GCA Box" from AESO Memorandum Report No. 9933, Revision D March 2011.

[3] SO2 Emission Factor adjusted as recommended for operations after 2010 in AESO Memorandum report No 2012-01, May 2012

Table 2.1 Emission Factors for EA-18G(F414-GE-400 Engines) In-Frame Aircraft Maintenance, per test, one engine

Test Type	Annual # tests	Fuel used (lbs)	Emissions from Maintenance Tests (lb/test)					
			CO	NOx	HC	SO_2[3]	PM10	CO2
Water Wash	1.0	120.0	14.32	0.22	6.05	0.26	1.44	369.57
Low Power	1.0	364.07	34.16	1.21	22.71	0.74	4.40	1085.62
High Power	1.0	3187.56	521.51	45.34	27.78	6.50	9.80	9252.70

[1] Fuel used and emission factors for estimated annual maintenance operations per test, per engine based on ratio from AESO Memorandum Report No. 9815, Rev G, March 2011.

[3] SO2 Emission factor adjusted as recommended for operations after 2010 in AESO Memorandum report No 2012-01, May 2012

Table 2.2 Emission Factors for EA-18G In-Frame Aircraft Maintenance[1]

Test Type	Annual # tests	# engines in use	Fuel used (lbs)	Emissions from Maintenance Test (lb/aircraft-yr)					
				CO	NOx	HC	SO_2[3]	PM10	CO2
Water Wash	1.0	1.0	132.0	11.41	0.47	7.57	0.26	1.47	369.57
Low Power, 1 engine	15.0	1.0	5461.0	512.45	18.11	340.70	11.12	65.95	16284.26
High Power	8.0	2.0	51001.0	8344.08	725.39	444.43	104.04	156.87	148043.20

Notes:

[1] Estimated annual maintenance operations from AESO Memorandum Report No. 9815, Rev G, March 2011.

[3] SO2 Emission Factor adjusted as recommended for operations after 2010 in AESO Memorandum report No 2012-01, May 2012

Table 2.3 Emission Factors for EA-18G Out-of-Frame (Test Cell)Aircraft Maintenance, per test[1]

Test Type	Annual # tests	# engines in use	Fuel used (lbs)	Emissions from Maintenance Test (lb/test)					
				CO	NOx	HC	SO_2[3]	PM10	CO2
Performance Test	1.0	1.0	10458.6	587.18	270.16	78.22	21.32	36.72	32204.17

Notes:

[1] AESO Memorandum Report "F414-GE-400 Engine Test Cell Emissions Estimates" No. 2000-22, Rev A, March 2011.

[3] SO2 Emission Factor adjusted as recommended for operations after 2010 in AESO Memorandum report No 2012-01, May 2012

Table 3 EA-6B (J52-P-408A) Emission Factors

Flight Operation	Fuel used (lbs)	Emissions from Single Flight Operation[1,2] (lb/op)					
		CO	NO_x	HC	SO_2[3]	PM_{10}	CO_2
Straight-In Arrival LTO	2181	61.40	11.50	29.28	4.44	31.28	6787.80
Break Arrival LTO	2114	61.24	11.41	29.35	4.34	30.28	6554.80
Touch-and-Go/FCLP	600.6	2.95	4.65	0.50	1.22	5.83	1906.33
Depart&Reenter/ GCA Box (GCA Pattern)	1061	6.24	7.43	0.97	2.14	11.18	3365.98

Notes:

[1] Fuel used and Emission factors for "Departure" and "Straight-In Arrival" from AESO Memorandum Report No. 9917, Rev C, December 2009.

[2] Emission factors for "Touch-and-Go" and "GCA Box" from AESO Memorandum Report No. 9941, Revision A, August 2002.

[3] SO2 Emission Factor adjusted as recommended for operations after 2010 in AESO Memorandum report No 2012-01, May 2012

Table 4.1 Emission Factors for EA-6B (J52-P-408A Engines) Aircraft Maintenance, per test, one engine

Test type	# tests	Fuel used (lbs)	Emissions from Maintenance Tests (lbs)[1]					
			CO	NOx	HC	SO_2	PM10	CO2
Water Wash	1.0	396.0	13.34	1.45	5.83	0.81	6.65	1223.78
Low Power	1.0	646.58	22.06	2.35	9.69	1.32	10.91	1997.23
High Power	1.0	2123.15	22.18	19.15	7.80	4.33	20.22	6708.03

[1] Refer to Table EA-6B Maintenance Run Up Operation Emission Factors in this Appendix.

Table 4.2 Emission from EA-6B (J52-P-408A Engines) Aircraft Test Cell Maintenance

	Fuel used (lbs)[2,3]	Single Engine Test Emissions					
		CO	NOx	HC	SO_2	PM10	CO2[4]
Average pounds of Emissions per 1000 lbs fuel[1]	1000.0	7.68	9.19	3.03	2.04	8.82	3160.37
TPY Emissions from 2011 JP5 Fuel use	818,720	3.14	3.76	1.24	0.84	3.61	1293.73

[1]As provided in Whidbey Island Air operating Permit Number 008, issued July 27 2004

[2]Total 2011 fuel used for J52-P-408B Engine testing in test cells T6 and T10 of 120,400 gallons, reported by NAS WI Air Quality specialist Dina Torgersen, June 6, 2012

[3]JP-5 density: 6.8 lbs/gallon

[4]CO2 EF not included in AQ data. Assumed based on emission index for J52-P-408A for 75% powersetting(see Maint EF EA6B)

Table 5 EA-6B Maintenance Run Up Operation Emission Factors

Operation	# Ops	Engine Power Setting[1]	No. of Engines in Use[1]	Time-In Mode per Engine (min)[1]	Flow Rate per Engine (lb/hr)[2]	Fuel Used (lbs)[3]	Emission Indexes 1 (pounds per 1,000 pounds fuel)[2] EI CO	EI CO_2	EI NO_x	EI HC	EI SO_2	EI PM_{10}	Emissions from Maintenance Run Ups[4] (lbs) CO	CO_2	NO_x	HC	SO_2	PM_{10}
Water Wash, see Low Power																		
Water Wash, 1 Engine																		
Main eng run	1	Idle	1	15	779	195	55.96	3018	2.38	28.33	2.04	19.940	10.898	587.756	0.464	5.517	0.397	3.883
Main eng run	1	75% N2	1	5	2415	201	12.11	3160.37	4.91	1.53	2.04	13.770	2.437	636.024	0.988	0.308	0.411	2.771
						396		**Total Emissions per Operation (lbs):**					13.34	1,223.78	1.45	5.83	0.81	6.65
Low Power, 1 Engine																		
Main eng run	1	Idle	1	25	779	325	55.96	3018	2.38	28.33	2.04	19.940	18.164	979.593	0.773	9.195	0.662	6.472
Main eng run	1	75% N2	1	8	2415	322	12.11	3160.37	4.91	1.53	2.04	13.770	3.899	1017.639	1.581	0.493	0.657	4.434
						647		**Total Emissions per Operation (lbs):**					22.06	1,997.23	2.35	9.69	1.32	10.91
High Power, 1 Engine																		
Engine start	1	Idle	1	16	779	208	55.96	3018	2.38	28.33	2.04	19.940	11.625	626.939	0.494	5.885	0.424	4.142
Intermed power	1	70% N2	1	15	1825	456	18.09	3160.37	4.3	2.4	2.04	15.410	8.254	1441.919	1.962	1.095	0.931	7.031
High Power	1	98% N2	1	10	8755	1,459	1.58	3179.33	11.44	0.56	2.04	6.200	2.305	4639.172	16.693	0.817	2.977	9.047
						2,123		**Total Emissions per Operation (lbs):**					22.18	6,708.03	19.15	7.80	4.33	20.22

Notes:

[1] Power Setting, # Engines in Use, and Time in mode values from Noise Report Data April 22, 2012.

[2] Fuel flow and emission indexes from "J52-P-408 Engine Fuel Flow and Emission Indexes by Percentage of Core RPM (%N2)", AESO January 1999, as reported in AESO Memorandum Report No. 9917, Rev C, December 200

[3] Fuel used = fuel flow x time-in-mode / 60 x no. of engines in use.

[4] Emissions = fuel used / 1,000 x emission index

Table 6 All EA 6B and EA18G Air Operations at Ault Field (Noise Analysis, 4/21/2012)

	Existing Operations (Baseline)		Proposed		
	EA-6B VAQ Squadrons	EA-18G VAQ Squadrons	EA-18G 1 Res Sqn	EA-18G VAQ Squadrons	EA-18G VAQ Total (40+39+14)
# Aircraft	40	39			93
Departures	1,962	1,913	459	3,875	4,334
Interfacility Departures	195	190	0	385	385
Straight in Arrivals	906	883	247	1,789	2,036
Overhead Break Arrivals	1,056	1,030	213	2,086	2,299
Interfacility Arrivals	195	190	0	385	385
Touch & Go Ops[2]	4,297	4,189	914	8,486	9,400
FCLP Ops[2]	8,595	8,380	0	16,975	16,975
Depart-Re-enter Ops[2]	114	112	25	226	251
GCA pattern Ops[2]	1,730	1,688	320	3,418	3,738
Total	**19,050**	**18,575**	**2,178**	**37,625**	**39,803**
Maintenance Run Ups					
Water Wash	445	86			195
Low Power	1,067	2,592			3,440
High Power	4	10			18
Test Cell Maintenance Run Ups[3]					
Test Cell Bldg 225 or 2756		71			

[1] Operations information from Aircraft Noise Study for NAS Whidbey Island and OLF Coupville (Wyle report WR 10-22), Wyle Laboratories, March, 2012. Noise analysis does not include test cell operations.

[3] One circuit counted at two operations (one take of and one landing), while emission factors are applied to the entire circuit--therefore reported operations on air tables will be half operations reported by noice anlysis as listed in these tables

[4] Baseline 2011 test cell operations as estimated in Aircraft Noise Study for the Introduction of the P-8A Multi-Mission Maritime Aircraft in to the Fleet, July 2008

Table 7 Expeditionary VAQ EA Action Only:Air Operations at Ault Field

	Existing Operations (Baseline)		Proposed Alt 1	Proposed Alt 2/3
	EA-6B VAQ Squadrons	EA-18G VAQ Squadrons	EA-18G	EA-18G
# Aircraft	12	0	21	26
Departures	589	0	979	1,212
Interfacility Departures	0	0	0	0
Straight in Arrivals	272	0	460	569
Overhead Break Arrivals	317	0	519	643
Interfacility Arrivals	0	0	0	0
Touch & Go Ops[2]	1,289	0	2,123	2,628
FCLP Ops[2]	0	0	0	0
Depart-Re-enter Ops[2]	34	0	57	70
GCA pattern Ops[2]	519	0	844	1,045
Total	**3,020**	**0**	**4,981**	**6,167**
Maintenance Run Ups				
Water Wash	134	0	44	55
Low Power	320	0	777	962
High Power	1	0	4	5
Test Cell Maintenance Run Ups[3]				
Test Cell Bldg 225 or 2756			38	47

[1] Operations estimated based on ratio of # of aircraft subject to the action to information from Aircraft Noise Study for NAS Whidbey Island and OLF Coupville (Wyle report WR 10-22), Wyle Laboratories, April, 2012

[3] One circuit counted at two operations (one take of and one landing), while emission factors are applied to the entire circuit--therefore reported operations on air tables will be half operations reported by noice anlysis as listed in these tables

[3] Test cell operations estimated based on ratio of # of aircraft subject to this action and information in Aircraft Noise Study for the Introduction of the P-8A Multi-Mission Maritime Aircraft in to the Fleet, July 2008

Table 8 Existing Operations Related to Action
Existing Expeditionary VAQ EA-6B Aircraft Operations at NAS Whidbey Island

Operation	No. of Operations[1]	Fuel use (lbs)	Emissions (tpy)[3]					
			CO	NO_x	HC	SO_2	PM_{10}	CO_2
Flight Operations								
Straight-In Arrival LTO[2]	272	592,796	8.34	1.56	3.98	0.60	4.25	922.46
Break Arrival LTO[2]	317	669,715	9.70	1.81	4.65	0.69	4.80	1,038.28
Touch-and-Go[4]	645	387,117	0.95	1.50	0.16	0.39	1.88	614.36
FCLP[4]	0	0	0.00	0.00	0.00	0.00	0.00	0.00
Depart and Re-enter[4]	17	24,128	0.01	0.25	0.00	0.02	0.07	38.47
GCA Pattern[4]	260	366,155	0.13	3.76	0.02	0.37	1.02	583.75
Total Emissions for Flight Operations		**2,039,910.3**	**19.1**	**8.9**	**8.8**	**2.1**	**12.0**	**3,197.3**
Maintenance Operations								
Water Wash	134	52,866	0.89	0.10	0.39	0.05	0.44	81.69
Low Power	320	206,971	3.53	0.38	1.55	0.21	1.75	319.66
High Power	1	2,548	0.01	0.01	0.00	0.00	0.01	4.02
Test Cell[5]	NA	818,720	3.14	3.76	1.24	0.84	3.61	1,293.73
Total Emissions for Maintenance Operations		**1,081,105.1**	**7.6**	**4.2**	**3.2**	**1.1**	**5.8**	**1,699.1**
Total		**3,121,015.4**	**26.7**	**13.1**	**12.0**	**3.2**	**17.8**	**4,896.4**

Notes:

[1] See Table 7 fo thie Appendix for Calculation of Estimated Operations

[2] All LTOs represent 2 operations, a Departure and Break or Straight-In Arrival

[3] Emissions calculated using AESO Report emission factors: #Ops x EF(lbs emission/op)/2000

[4] Touch and Go/FCLP, and Depart&Reenter/GCA Pattern operations are counted as two operations in Wyle calculations, but only once for air emission calculation purposes

[5] See Table 4.2 for information on existing test cell emission assumption methods

Table 9 Alternative 1: Proposed Additional Operations and Related Increase in Emissions from Expeditionary VAQ EA-18G Aircraft Operations at NAS Whidbey Island

Operation	No. of New Operations[1]	Fuel use (lbs)	Emissions (tpy)[3]					
			CO	NO_x	HC	SO_2	PM_{10}	CO_2
Flight Operations								
Straight-In Arrival LTO[2]	460	1,200,846	60.98	7.14	16.02	1.22	4.19	1,798.51
Break Arrival LTO[2]	519	1,312,358	69.16	8.09	18.24	1.34	4.55	1,960.52
Touch-and-Go[4]	1,061	749,271	0.27	7.68	0.04	0.76	2.10	1,193.70
FCLP[4]	0	0	0.00	0.00	0.00	0.00	0.00	0.00
Depart and Re-enter[4]	28	39,986	0.01	0.41	0.00	0.04	0.11	63.75
GCA Pattern[4]	422	595,488	0.21	6.11	0.04	0.60	1.66	949.37
Total Emissions for Flight Operations		**3,897,948.5**	**130.6**	**29.4**	**34.3**	**4.0**	**12.6**	**5,965.9**
Maintenance Operations								
Water Wash	44	5,284	0.32	0.005	0.13	0.006	0.03	8.14
Low Power	777	282,798	13.27	0.47	8.82	0.29	1.71	421.64
High Power	4	12,956	1.06	0.09	0.06	0.01	0.02	18.80
Test Cell	38	399,840	11.22	5.16	1.50	0.41	0.70	615.60
Total Emissions for Maintenance Operations		**700,877.7**	**25.9**	**5.7**	**10.5**	**0.7**	**2.5**	**1,064.2**
Total		**4,598,826.2**	**156.5**	**35.2**	**44.8**	**4.7**	**15.1**	**7,030.0**

Notes:

[1] See Table 7 of this Appendix for Calculation of Estimated Operations

[2] All LTOs represent 2 operations, a Departure and Break or Straight-In Arrival

[3] Emissions calculated using AESO Report emission factors: #Ops x EF(lbs emission/op)/2000

[4] Touch and Go/FCLP, and Depart&Reenter/GCA Pattern operations are counted as two operations in Wyle calculations, but only once for air emission calculation purposes

Table 10 Alternative 2 and 3: Proposed Additional Operations and Related Increase in Emissions from Expeditionary VAQ EA-18G Aircraft Operations at NAS Whidbey Island

Operation	No. of Operations[1]	Fuel use (lbs)	Emissions (tpy)[3]					
			CO	NO_x	HC	SO_2	PM_{10}	CO_2
Flight Operations								
Straight-In Arrival LTO[2]	569	1,486,762	75.50	8.85	19.84	1.51	5.18	2,226.72
Break Arrival LTO[2]	643	1,624,824	85.63	10.01	22.58	1.66	5.64	2,427.32
Touch-and-Go[4]	1,314	927,669	0.33	9.51	0.05	0.94	2.60	1,477.92
FCLP[4]	0	0	0.00	0.00	0.00	0.00	0.00	0.00
Depart and Re-enter[4]	35	49,506	0.02	0.51	0.00	0.05	0.14	78.93
GCA Pattern[4]	523	737,270	0.26	7.56	0.04	0.75	2.06	1,175.41
Total Emissions for Flight Operations		**4,826,031.5**	**161.7**	**36.4**	**42.5**	**4.9**	**15.6**	**7,386.3**
Maintenance Operations								
Water Wash	55	6,542	0.39	0.01	0.16	0.01	0.04	10.07
Low Power	962	350,130	16.43	0.58	10.92	0.36	2.11	522.03
High Power	5	16,041	1.31	0.11	0.07	0.02	0.02	23.28
Test Cell	47	495,040	13.90	6.39	1.85	0.50	0.87	762.17
Total Emissions for Maintenance Operations		**867,753.3**	**32.0**	**7.1**	**13.0**	**0.9**	**3.0**	**1,317.6**
Total		**5,693,784.8**	**193.8**	**43.5**	**55.5**	**5.8**	**18.7**	**8,703.8**

Notes:

[1] See Table 7 of this Appendix for Calculation of Estimated Operations

[2] All LTOs represent 2 operations, a Departure and Break or Straight-In Arrival

[3] Emissions calculated using AESO Report emission factors: #Ops x EF(lbs emission/op)/2000

[4] Touch and Go/FCLP, and Depart&Reenter/GCA Pattern operations are counted as two operations in Wyle calculations, but only once for air emission calculation purposes.

Table 11 Existing and Projected Emissions from Expeditionary VAQ Aircraft Operations at NAS Whidbey

Operation	No. of Operations[1]	Emissions (tpy)[2]				
		CO	NO_x	HC	SO_2	PM_{10}
Existing EA-6B Operations (12 Aircraft)						
LTOs	589	18.0	3.4	8.6	1.3	9.0
Pattern Operations	1,842	1.1	5.5	0.2	0.8	3.0
Total Emissions from Flight Operations		**19.1**	**8.9**	**8.8**	**2.1**	**12.0**
Water Wash	134	0.9	0.1	0.4	0.05	0.4
Low Power	320	3.5	0.4	1.6	0.2	1.7
High Power	1	0.01	0.0	0.00	0.003	0.01
Test Cell	NA	3.14	3.8	1.24	0.835	3.61
Total Emissions from Maintenance Operations		**7.6**	**4.2**	**3.2**	**1.1**	**5.8**
Total Emissions from Existing Exp VAQ EA-6B Operations		**26.7**	**13.1**	**12.0**	**3.2**	**17.8**
Alternative 1: Projected EA-18 G Operations (21 Aircraft)						
EA-18G						
LTOs	979	130.1	15.2	34.3	2.6	8.7
Pattern Operations	3,023	0.5	14.2	0.1	1.4	3.9
Total Emissions from Flight Operations		**130.6**	**29.4**	**34.3**	**4.0**	**12.6**
Water Wash	44	0.3	0.005	0.1	0.006	0.03
Low Power	777	13.3	0.5	8.8	0.3	1.7
High Power	4	1.1	0.1	0.1	0.0	0.0
Test Cell	38	11.2	5.2	1.5	0.4	0.7
Total Emissions from Maintenance Operations		**25.9**	**5.7**	**10.5**	**0.7**	**2.5**
Total Emissions from Proposed Exp VAQ EA-18G Operations		**156.5**	**35.2**	**44.8**	**4.7**	**15.1**
Total Change in Aircraft Operation Emissions		**129.8**	**22.0**	**32.9**	**1.5**	**-2.8**
Alternative 2 and 3: Projected EA-18 G Operations (26 Aircraft)						
EA-18G						
LTOs	1,212	161.1	18.9	42.4	3.2	10.8
Pattern Operations	3,743	0.6	17.6	0.1	1.7	4.8
Total Emissions from Flight Operations		**161.7**	**36.4**	**42.5**	**4.9**	**15.6**
Water Wash	55	0.4	0.0	0.2	0.0	0.0
Low Power	962	16.4	0.6	10.9	0.4	2.1
High Power	5	1.3	0.1	0.1	0.0	0.0
Test Cell	47	13.9	6.4	1.9	0.5	0.9
Total Emissions from Maintenance Operations		**32.0**	**7.1**	**13.0**	**0.9**	**3.0**
Total Emissions from Proposed Exp VAQ EA-18G Operations		**193.8**	**43.5**	**55.5**	**5.8**	**18.7**
Total Change in Aircraft Operation Emissions		**167.1**	**30.4**	**43.5**	**2.6**	**0.8**

Notes:

[1] Operations information from Aircraft Noise Study for NAS Whidbey Island and OLF Coupville (Wyle report WR 10-22), Wyle Laboratories, September 2010

[2] Emissions calculated using emission factors provided in Table 1: #Ops x EF(lbs emission/op)/2000

Table 12 Facility Construction - NAS Whidbey Island

Alternative	total sq ft	Acres
Alternative 1		
New Construction	41,700.00	0.96
Impervious Surface (Paving)	9,200.00	0.21
Total affected area	50,900.00	1.17
Demolition	38,636.00	0.89
Alternative 2		
New Construction Area	66,900.00	1.54
Impervious Surface (Paving)	9,200.00	0.21
Total graded space	76,100.00	1.75
Demolition	38,636.00	0.89
Alternative 3		
New Construction Area	46,000.00	1.06
Impervious Surface (Paving)	9,200.00	0.21
Total graded space	55,200.00	1.27
Demolition	38,636.00	0.89

Emission calculations assume all activities will be performed within one year

Work will occur 8 hours per day, 250 days in the year

An average of 35 construction workers per day

An Average of 2 Construction deliveries per day

Table 13 Nonroad Construction Equipment Exhaust Emission Factors

Equipment Type	Fuel Type	SCC	Avg Size[1] (hp)	Load[2]	Engine Size Range	Emission Factor[3] (g/hp-hr)						Equipment Emission Rate[4] (lbs-hr)					
						VOC	CO	NO_x	SO_2	PM_{10}	CO_2	VOC	CO	NO_x	SO_2	PM_{10}	CO_2
Asphalt Paving Machine	Diesel	2270002003	91	0.59	75<hp≤100	0.337	3.098	3.599	0.007	0.434	595.102	0.040	0.367	0.426	0.001	0.051	70.439
Vibratory Compactor	Diesel	2270002009	8	0.43	6<hp≤11	0.681	4.490	4.952	0.007	0.501	588.218	0.005	0.034	0.038	0.000	0.004	4.461
Generators	Diesel	2270006005	22	0.43	16<hp≤25	0.823	3.026	5.360	0.007	0.488	588.051	0.017	0.063	0.112	0.000	0.010	12.264
Air Compressors	Diesel	2270006015	37	0.43	25<hp≤40	0.250	1.278	4.283	0.007	0.228	588.575	0.009	0.045	0.150	0.000	0.008	20.644
Tractors/Loaders/Backhoes	Diesel	2270002066	77	0.21	75<hp≤100	1.033	6.128	5.138	0.008	0.912	692.767	0.037	0.218	0.183	0.000	0.033	24.696
Aerial Lifts (Cherry Pickers	Diesel	2270003010	43	0.21	40<hp≤50	1.810	6.781	5.879	0.008	0.978	690.333	0.036	0.135	0.117	0.000	0.019	13.743
Crawler Tractor/Dozers	Diesel	2270002069	157	0.59	100<hp≤175	0.206	1.000	2.435	0.006	0.241	536.182	0.042	0.204	0.497	0.001	0.049	109.494
Off-Highway Trucks	Diesel	2270002051	489	0.59	300<hp≤600	0.154	0.783	1.971	0.006	0.130	536.345	0.098	0.498	1.254	0.004	0.083	341.140

Notes:

1. Avg hp from "Nonroad Engine and Vehicle Emissions Study Report" EPA 460/3-91-02. Nov 1991.
2. Load from "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling" EPA420-P-04-005. April 20(
3. Emission factors from EPA's NONROAD model (Year 2014) for Island County, Washington. VOC emissions include both Exhaust and Crankcase Emissions
4. Equipment Emission Rate = Average HP x Load x Emission Factor x 453.6 g/lt

Table 14 Mobile Equipment Exhaust Emissions, Construction and Demolition Equipment Use On Site

Activity -- Alt 1	Equipment List	Eqpt qty	Days Used	Emission Factors (lb/day/unit)[1]						Emissions (TPY)					
				VOC	CO	NO_X	SO_2	PM_{10}	CO_2	VOC	CO	NO_X	SO_2	PM_{10}	CO_2
Demolition	Loader	1	60	0.29	1.75	1.47	0.002	0.26	197.57	0.01	0.05	0.04	0.000	0.01	5.93
	Haul Truck	1	60	0.78	3.98	10.03	0.031	0.66	2729.12	0.02	0.12	0.30	0.001	0.02	81.87
Excavation	Backhoe Loader	1	60	0.29	1.75	1.47	0.002	0.26	197.57	0.01	0.05	0.04	0.000	0.01	5.93
	Haul Truck	1	60	0.78	3.98	10.03	0.031	0.66	2729.12	0.02	0.12	0.30	0.001	0.02	81.87
Cut and fill	Scraper	1	60	0.34	1.63	3.98	0.010	0.39	875.95	0.01	0.05	0.12	0.000	0.01	26.28
	Bulldozer	1	60	0.34	1.63	3.98	0.010	0.39	875.95	0.01	0.05	0.12	0.000	0.01	26.28
	Water Truck	1	60	0.78	3.98	10.03	0.031	0.66	2729.12	0.02	0.12	0.30	0.001	0.02	81.87
Trenching	Trencher	1	60	0.29	1.75	1.47	0.002	0.26	197.57	0.01	0.05	0.04	0.000	0.01	5.93
	Track loader	1	60	0.29	1.75	1.47	0.002	0.26	197.57	0.01	0.05	0.04	0.000	0.01	5.93
Grading	Grader	1	60	0.34	1.63	3.98	0.010	0.39	875.95	0.01	0.05	0.12	0.000	0.01	26.28
	Bulldozer	1	60	0.34	1.63	3.98	0.010	0.39	875.95	0.01	0.05	0.12	0.000	0.01	26.28
	Water Truck	1	60	0.78	3.98	10.03	0.031	0.66	2729.12	0.02	0.12	0.30	0.001	0.02	81.87
Concrete Slab pouring	Cement Truck	1	30	0.78	3.98	10.03	0.031	0.66	2729.12	0.01	0.06	0.15	0.000	0.01	40.94
	Compactor	1	30	0.04	0.27	0.30	0.000	0.03	35.69	0.00	0.00	0.00	0.000	0.00	0.54
Portable Equipment	Generator	1	125	0.14	0.50	0.89	0.001	0.08	98.11	0.01	0.03	0.06	0.000	0.01	6.13
	Air Compressor	1	125	0.07	0.36	1.20	0.002	0.06	165.15	0.00	0.02	0.08	0.000	0.00	10.32
Paving	Paving Machine Roller	1	30	0.32	2.93	3.41	0.007	0.41	563.51	0.00	0.04	0.05	0.000	0.01	8.45
	Haul Truck	1	30	0.78	3.98	10.03	0.031	0.66	2729.12	0.01	0.06	0.15	0.000	0.01	40.94
Architectural Coatings	Air Compressor	1	60	0.07	0.36	1.20	0.002	0.06	165.15	0.00	0.01	0.04	0.000	0.00	4.95
									Annual Emissions (TPY)	**0.2**	**1.1**	**2.4**	**0.006**	**0.195**	**568.6**

[1] Calculated using EPA NONROAD equipment emission rates (see Table 6), assuming operation for 8 hours per day.

Table 15 Particulate Emissions from Construction

Activity	ACRES	ACTIVITY DAYS	BULLDOZING (LBS)(1)	PAN SCRAPING SOIL REMOV(LBS)(2)	PAN SCRAPING ETHMOVING (LBS)(3)	EMISSIONS	
						lbs	Tons
Total Disturbed Acreage Alt 1	1.17	60	360	19	12	390	0.20
Total Disturbed Acreage Alt 2	1.75	60	360	28	18	406	0.20
Total Disturbed Acreage Alt 3	1.27	60	360	20	13	393	0.20

(1) Bulldozing dust emissions based on 8hr/activity day

(2) Soil removal dust emissions based on VMT/acre

(3) Earthmoving dust emissions based on soil removal miles

EPA 1992 Fugitive Dust Background document (EPA-450/2-92-004) used as data reference.

(4) Volumes provided by M. Byrne, E CIV NAVFAC Lant from M. Cowley

(5) Emissions calcuated using NCDENR Concrete Batch Plant Emission Calculator, rev A, issued 1/23/2006
retreived from http://daq.state.nc.us/cgi-bin/permit_forms.cgi?id=conbat&type=sheets

Table 16 VOC EMISSIONS FROM PAVING

Activity	Acres Paved	Emission Factor(1) (lbs/acre)	EMISSIONS	
			LBS/YR	TPY
Paving (total)	0.21	2.62	16.6	0.008

(1) URBEMIS 9.2.4, 2007

Table 17 VOC Emissions form Architectural Coatings

Activity	Sq ft surfaces[1]	Est. Paint Qty (gal)[2]	Avg VOC Content (lb/gal)	EMISSIONS	
				LBS/YR	TPY
New Built Space					
Alternative 1	133440	445	5	2224	1.11
Alternative 2	214080	714	5	3568	1.78
Alternative 3	147200	491	5	2453	1.23

[1]assumes total sq ft is divided to 10x10 spaces, with 8 ft ceilings

[2]assumes one gallon covers 300 sq ft

Table 18 Onroad Vehicle Exhaust Emission Factors

Equipment Type	Fuel Type	Exhaust Emission Factor[a,b,c] (g/VMT)							Road Dust Emission Factor[d] (g/VMT)		Total PM Emission Factor[e] (g/VMT)	
		VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Cars and Light Trucks	Gasoline	1.49	14.05	1.09	0.0127	0.0059	0.0055	440	3.13	0.341	3.13	0.347
Delivery Vehicles	Diesel	0.28	1.10	8.06	0.158	0.17	0.17	1,400	3.13	0.341	3.30	0.511

Notes:

a. Emission factors for gasoline worker vehicles from "Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks (EPA420-F-05-22, EPA 2005). It was assumed that the vehicle make-up included 50% car

b. Emission factors for diesel worker and delivery vehicles (except SO2 and CO2) from "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level- Final Report" (U.S. Federal Highway Administration 2005).

c. CO_2 and SO_2 emission factors for diesel worker and delivery vehicles from "Greenhouse Gas Protocol - Corporate Accounting and Reporting Standard / Mobile Guide" (World Resources Institute/World Business Council for Sustainable Development 2005). SO2

d. See emission factor derivation table below.

e. Sum of exhaust and road dust emission factors.

Paved Roads - Emission Factor Derivation

$E = (k(sL/2)^{0.65}(W/3)^{1.5}-C)$ AP-42 Section 13.2.1 (11/06 version)

where:

E = particulate emission factor (lb/VMT)

k = particle size multiplier

sL = road surface silt loading (g/m^2)

W = average vehicle weight (tons)

C = emission factor for 1980's vehicle fleet exhaust, break wear and tire wea

Parameter	Units	PM_{10}	$PM_{2.5}$	Reference
Mean Vehicle Weight	tons	3	3	Assumption
k factor	g/VMT	7.3	1.1	Table 13.2-1.1
Silt Loading, sL	g/m^2	0.6	0.6	Table 13.2.1-3
Emission factor, C	g/VMT	0.2119	0.1617	Table 13.2.1-2
Emission factor, E	g/VMT	3.13	0.341	Table 13.2.1-3

Table 19 Ground Transportation Vehicle Emissions for Construction Vehicles

Source	# of vehicles[2]	Avg Daily mileage[3]	Total Annual Miles	Emission Factors (lbs/mi)[1]							Emissions (tpy)						
				VOC	CO	NO_x	SO_2	CO_2	PM_{10}	$PM_{2.5}$	VOC	CO	NO_x	SO_2	CO_2	PM_{10}	$PM_{2.5}$
Deliveries	2	50	25,000	0.0006	0.0024	0.0178	0.0003	3.0864	0.0073	0.0011	0.01	0.03	0.22	0.004	39	0.09	0.01
Worker commute	35	30	262,500	0.0033	0.0310	0.0024	0.0000	0.9700	0.0069	0.0008	0.43	4.07	0.31	0.004	127	0.91	0.10
									Total Ground Vehicle Emissions		**0.44**	**4.10**	**0.54**	**0.01**	**166**	**1.00**	**0.11**

[1] See Emission factors in Table 11 of this Appendi:
[2] See Construction Assumptions, Table 5 of this Appendi:
[3] Based on use of local landfills for wastes and local sources for construction material

Table 20 Ground Transportation Vehicle Emissions for New POV

Source	# of vehicles[2]	Avg Daily mileage	Annual days of Commute	Total Annual Miles[3]	Emission Factors (lbs/mi)[1]							Emissions (tpy)						
					VOC	CO	NO_x	SO_2	CO_2	PM_{10}	$PM_{2.5}$	VOC	CO	NO_x	SO_2	CO_2	PM_{10}	$PM_{2.5}$
Changes to POV Operations resulting from addition of VAQ-209 Staff																		
Alternative 1																		
Full-time	51	25	250	317,983	0.0033	0.0310	0.0024	0.0000	0.9700	0.0069	0.0008	0.52	4.92	0.38	0.004	154	1.10	0.12
Part-time	40	25	62.5	250,767	0.0033	0.0310	0.0024	0.0000	0.9700	0.0069	0.0008	0.41	3.88	0.30	0.003	122	0.87	0.10
Total	**91**			**568,750**								**0.93**	**8.81**	**0.68**	**0.01**	**275.85**	**1.96**	**0.22**
Alternative 2 and 3																		
Full-time	174	25	250	1,086,733	0.0033	0.0310	0.0024	0.0000	0.9700	0.0069	0.0008	1.78	16.83	1.30	0.015	527	3.75	0.42
Part-time	137	25	62.5	857,017	0.0033	0.0310	0.0024	0.0000	0.9700	0.0069	0.0008	1.40	13.27	1.02	0.012	416	2.96	0.33
Total	**311**			**1,943,750**								**3.18**	**30.10**	**2.32**	**0.03**	**942.74**	**6.71**	**0.74**

[1] See Emission factors in Table 18 of this Appendix

[2] Based on increase in personnel associated with alternative action as revised 7/3/2012, per ratio of Full time/Part time (123/97) personnel provided by LCDR Ross, 6/1/2012

[3] Based on 250 days for commute

Table 21 Construction Emissions NAS Whidbey Island, All Alternatives

Activity	Emissions (TPY)				
	VOC	CO	NO_X	SO_2	PM_{10}
Alternative 1					
Construction equipment	0.21	1.12	2.38	0.01	0.20
VOCs from paving and painting	1.12				
PM_{10} from grading and demolition					0.20
Worker Commute and Deliveries	4.10	0.54	0.44	0.01	1.00
Total	**5.43**	**1.65**	**2.82**	**0.01**	**1.39**
Alternative 2					
Construction equipment	0.21	1.12	2.38	0.01	0.20
VOCs from paving and painting	1.79	5.20			
PM_{10} from grading and demolition					0.20
Worker Commute and Deliveries	4.10	0.54	0.44	0.01	1.00
Total	**6.10**	**6.85**	**2.82**	**0.01**	**1.40**
Alternative 3					
Construction equipment	0.21	1.12	2.38	0.01	0.20
VOCs from paving and painting	1.23	2.95			
PM_{10} from grading and demolition					0.20
Worker Commute and Deliveries	4.10	0.54	0.44	0.01	1.00
Total	**5.54**	**4.60**	**2.82**	**0.01**	**1.39**

Key:

CO = Carbon monoxide.
NOx = Nitrogen oxides.
PM_{10} = Particulate matter less than 10 microns in diameter.
Tpy = Tons per year.
VOC = Volatile organic compound.

Table 22 Existing and Projected Emissions from Aircraft and POV Operations at NAS Whidbey

Operation	Emissions (tpy)				
	CO	NO_x	HC	SO_2	PM_{10}
Existing EA-6B Operations (12 Aircraft)					
LTOs[1]	18.0	3.4	8.6	1.3	9.0
Pattern Operations[2]	1.1	5.5	0.2	0.8	3.0
Total Emissions from Flight Operations	**19.1**	**8.9**	**8.8**	**2.1**	**12.0**
Water Wash	0.9	0.1	0.4	0.05	0.4
Low Power	3.5	0.4	1.6	0.2	1.7
High Power	0.01	0.0	0.00	0.003	0.01
Test Cell	3.14	3.8	1.24	0.835	3.61
Total Emissions from Maintenance Operations	**7.6**	**4.2**	**3.2**	**1.1**	**5.8**
Total Emissions from Existing Exp VAQ EA-6B Operations	**26.7**	**13.1**	**12.0**	**3.2**	**17.8**
Alternative 1: Projected EA-18 G Operations (21 Aircraft)					
EA-18G					
LTOs	130.1	15.2	34.3	2.6	8.7
Pattern Operations	0.5	14.2	0.1	1.4	3.9
Total Emissions from Flight Operations	**130.6**	**29.4**	**34.3**	**4.0**	**12.6**
Water Wash	0.3	0.005	0.1	0.006	0.03
Low Power	13.3	0.5	8.8	0.3	1.7
High Power	1.1	0.1	0.1	0.0	0.0
Test Cell	11.2	5.2	1.5	0.4	0.7
Total Emissions from Maintenance Operations	**25.9**	**5.7**	**10.5**	**0.7**	**2.5**
Total Emissions from Proposed Exp VAQ EA-18G Operations	**156.5**	**35.2**	**44.8**	**4.7**	**15.1**
Total Change in Aircraft Operation Emissions	**129.8**	**22.0**	**32.9**	**1.5**	**-2.8**
Total Change in POV Emissions	**8.8**	**0.7**	**0.9**	**0.0**	**2.0**
Total Change in Operation Emissions	**138.6**	**22.7**	**33.8**	**1.5**	**-0.8**
Alternative 2 and 3: Projected EA-18 G Operations (26 Aircraft)					
EA-18G					
LTOs	161.1	18.9	42.4	3.2	10.8
Pattern Operations	0.6	17.6	0.1	1.7	4.8
Total Emissions from Flight Operations	**161.7**	**36.4**	**42.5**	**4.9**	**15.6**
Water Wash	0.4	0.0	0.2	0.0	0.0
Low Power	16.4	0.6	10.9	0.4	2.1
High Power	1.3	0.1	0.1	0.0	0.0
Test Cell Operations	13.9	6.4	1.9	0.5	0.9
Total Emissions from Maintenance Operations	**32.0**	**7.1**	**13.0**	**0.9**	**3.0**
Total Emissions from Proposed Exp VAQ EA-18G Operations	**193.8**	**43.5**	**55.5**	**5.8**	**18.7**
Total Change in Aircraft Operation Emissions	**167.1**	**30.4**	**43.5**	**2.6**	**0.8**
Total Change in POV Emissions	**30.1**	**2.3**	**3.2**	**0.0**	**6.7**
Total Change in Operation Emissions	**197.2**	**32.7**	**46.7**	**2.6**	**7.5**

Notes:

Notes:

1 LTOs include departure and arrival, auxiliary power unit (APU), idling, taxi, and run-up operations.

2 Pattern operations include Touch and Go, Depart/re-enter, and GCA Box operations.

Key:

CO = carbon monoxide

HC = hydrocarbon

NAS = Naval Air Station

NO_x = nitrogen oxides

PM_{10} = particles10 micrometers or less in diameter

POV = personally operated vehicle

SO_2 = sulfur dioxide

TPY = tons per year

VAQ = electronic attack

Table 23 GHG Emissions, All Alternatives

Emission Source	CO2 Emissions (Metric TPY)			
	Existing	Alt 1	Alt 2	Alt 3
Mobile Source Emissions				
Aircraft Emissions	4,896	7,030	8,704	7,030
Ground Vehicle Emissions	NA	276	943	943
Total CO2 Emissions (MTPY)	**4,896**	**7,306**	**9,647**	**7,973**
Total CO2 from all sources in Washington State, 2008		79,400,000		
Emissions as % of Total 2008 CO2 Emissions in Washington	0.006%	0.009%	0.012%	0.010%
Total CO2 from Transportation in Washington State, 2008		43,100,000		
Emissions as % of Total 2008 Transportation CO2 Emissions in Washington	0.011%	0.017%	0.022%	0.018%
Total CO2 from Transportation in the United States, 2008		1,930,100,000		
Emissions as % of Total 2008 CO2 Emissions in United States, 2008	0.0003%	0.0004%	0.000%	0.0004%

	CO2	unit	Source
Total CO2 from Energy and Industry 2008	5,839,300,000	metric tons	http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html#emissions
Total CO2 from Transportation, 2008	1,930,100,000	metric tons	http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html#emissions
Total CO2 from Energy and Industry, Washington State, 2008	79,400,000	metric tons	http://www.eia.doe.gov/oiaf/1605/state/state_emissions.html
Total CO2 from Transportation, Washington State, 2008	43,100,000	metric tons	http://www.eia.doe.gov/oiaf/1605/state/state_emissions.html

Table 24 Comparison of Percent Change in Mobile Source Emissions with NWCAA Region

	Emissions (tpy)[2]				
	CO	NO_x	VOCs	SO_2	PM_{10}
Change in Emissions Associated with Alternative 1	138.6	22.7	33.8	1.5	(0.8)
Total Mobile Source Emissions in Skagit, Island, and Whatcom Counties (NWCAA Region)[1]	140,341.2	23,747.8	12,735.6	2,983.4	1,159.4
% Change in Mobile Source Emissions in NWCAA Region, Alternative 1	0.10%	0.10%	0.27%	0.05%	-0.07%
Change in Emissions Associated with Alternative 2 and 3	197.2	32.7	46.7	2.6	7.5
% Change in Mobile Source Emissions in NWCAA Region, Alternative 2 and 3	0.14%	0.14%	0.37%	0.09%	0.65%

[1]Emission totals provided by NWAPA 2004. Total mobile emissions do not include aircraft emissions; therefore, existing aircraft emissions at NAS Whidbey Island as calculated in 2005 EA for Replacement of EA-6B with EA-18G analysis are added to the totals provided by NWAPA.