Appendix D: Air Quality Summaries

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FALLON RANGE TRAINING COMPLEX EIS AIR POLLUTANT EMISSIONS CALCULATIONS - AIRCRAFT

SOURCE INFORMATION										
Platform	Activity Information by Alternative									Fuel Flow (lb/hr)
	No Action Alternative			Alternative 1			Alternative 2			
	Sorties	Flight Time (Hours)	Percent Above 3,000 ft AGL	Sorties	Flight Time (Hours)	Percent Above 3,000 ft AGL	Sorties	Flight Time (Hours)	Percent Above 3,000 ft AGL	
Fixed-Wing Aircraft										
A-10	200	240	95%	213	256	95%	234	281	95%	6,052
AV-8	8	10	95%	9	11	95%	9	11	95%	4,313
B-52	4	2	100%	4	2	100%	5	3	100%	59,520
C-130	74	111	70%	79	119	70%	87	131	70%	8,272
EA-6B	1,384	2,353	100%	0	0	0%	0	0	0%	8,454
EA-18G	750	900	100%	2,273	3,410	100%	2,500	3,750	100%	10,338
E-2	1,156	2,081	100%	1,231	2,216	100%	1,354	2,437	100%	2,200
EP-3	10	18	100%	11	20	100%	12	22	100%	6,400
F-5	3,920	5,880	90%	4,175	6,263	85%	4,592	6,888	85%	3,504
F-15	30	48	85%	32	51	100%	35	56	100%	19,358
F-16	1,524	1,981	100%	1,623	2,110	85%	1,785	2,321	85%	11,490
FA-18	31,981	41,575	85%	22,718	29,533	85%	24,990	32,487	85%	10,338
F-21	181	217	85%	193	232	85%	212	254	85%	2,411
F-22	9	14	95%	10	15	95%	11	17	95%	2,740
F-35	0	0	85%	11,342	14,745	85%	12,476	16,219	85%	
KC-10	3	9	100%	3	9	100%	4	12	100%	59,214
KC-130	2	5	100%	2	5	100%	2	5	100%	4,500
KC-135	6	18	100%	6	18	100%	7	21	100%	25,832
OV-10	32	80	100%	34	85	100%	37	93	100%	387
P-3C/P-8 MMA	70	210	100%	75	225	100%	82	246	100%	6,400
RC-135	4	7	100%	4	7	100%	5	9	100%	38,520
T-34	267	481	70%	284	511	50%	313	563	50%	376
Total	**41,615**	**56,239**		**44,321**	**59,841**		**48,752**	**65,824**		
Rotary Aircraft										
AH-1	16	19	0%	17	20	0%	19	23	0%	812
AH-64	12	14	0%	13	16	0%	14	17	0%	1,268
CH-46	66	99	0%	70	105	0%	77	116	0%	1,200
CH-47	6	9	0%	6	9	0%	7	11	0%	2,376
CH-53	14	21	0%	15	23	0%	16	24	0%	4,200
H-60	1,286	1,929	5%	1,370	2,055	5%	1,507	2,261	5%	1,268
MV-22	2	3	40%	2	3	40%	2	3	40%	3,540
Total	**1,402**	**2,095**		**1,493**	**2,231**		**1,642**	**2,453**		
Unmanned Aerial Systems										
RQ-7B	169	135	0%	180	144	0%	196	157	0%	0.52
Total	**169**	**135**		**180**	**144**		**196**	**157**		
Grand Total	**43,186**	**58,469**		**45,994**	**62,215**		**50,590**	**68,433**		

Notes: AGL - above ground level.

See "Aircraft Source Information" tab for additional documentation of engine type, # of engines, flight mode, fuel flow, and emissions factors.

FALLON RANGE TRAINING COMPLEX EIS AIR POLLUTANT EMISSIONS CALCULATIONS - AIRCRAFT

SOURCE INFORMATION								
Platform	Fuel Use (pounds/year) <3,000 feet AGL			Emissions Factor (pounds/1,000 pounds fuel)				
	No Action	Alt 1	Alt 2	CO	NO_x	VOC	SO_x	PM_{10}
Fixed-Wing Aircraft								
A-10	72,624	77,345	84,970	4.00	8.83	0.40	1.34	2.67
AV-8	2,070	2,329	2,329	16.00	5.90	1.17	2.06	5.30
B-52	0	0	0	0.00	12.08	0.55	1.34	3.67
C-130	275,458	294,070	323,849	2.51	11.19	0.35	1.34	1.22
EA-6B	0	0	0	5.19	6.77	0.97	2.06	10.48
EA-18G	0	0	0	0.72	14.75	0.16	2.06	6.56
E-2	0	0	0	2.16	8.06	0.56	2.06	3.97
EP-3	0	0	0	1.12	9.47	0.29	2.06	3.97
F-5	2,060,352	3,291,570	3,620,333	33.24	3.66	1.24	2.06	7.25
F-15	139,378	0	0	0.86	29.32	1.79	1.34	1.33
F-16	0	3,636,413	3,999,382	0.66	57.65	0.54	1.34	1.33
FA-18	64,470,818	45,797,484	50,377,232	0.72	14.75	0.16	2.06	6.56
F-21	78,550	83,758	92,004	39.89	3.12	6.27	2.06	10.78
F-22	1,850	2,055	2,261	7.94	6.61	0.45	0.49	1.99
F-35	0	0	0	JSF tab	JSF tab	JSF tab	JSF tab	JSF tab
KC-10	0	0	0	0.50	36.54	0.60	1.34	1.18
KC-130	0	0	0	2.07	8.16	0.54	1.34	3.97
KC-135	0	0	0	0.63	15.28	0.30	1.34	1.59
OV-10	0	0	0	1.55	9.17	0.09	5.32	10.26
P-3C/P-8 MMA	0	0	0	1.12	9.47	0.29	2.06	3.97
RC-135	0	0	0	0.00	12.08	0.55	1.34	3.67
T-34	54,212	96,106	105,919	0.82	6.19	0.16	2.06	4.20
Total	**67,155,311**	**53,281,128**	**58,608,278**					
Rotary Aircraft								
AH-1	15,590	16,565	18,514	11.21	5.44	0.66	2.06	4.20
AH-64	18,259	19,781	21,302	5.66	6.56	0.63	2.06	4.20
CH-46	118,800	126,000	138,600	17.04	4.12	3.04	2.06	1.78
CH-47	21,386	21,386	24,950	3.94	6.85	0.99	2.06	2.21
CH-53	88,200	94,500	100,800	2.54	7.72	0.29	2.06	2.21
H-60	2,323,673	2,475,453	2,722,998	5.66	6.56	0.63	2.06	4.20
MV-22	6,372	6,372	6,372	0.60	13.19	0.01	2.06	1.58
Total	**2,592,281**	**2,760,056**	**3,033,536**					
Unmanned Aerial Systems								
RQ-7B	70	75	82	RQ-7 tab	RQ-7 tab	RQ-7 tab	RQ-7 tab	RQ-7 tab
Total	**69,747,662**	**56,041,259**	**61,641,896**					

Notes: lb - pounds, yr - year, ft - foot, CO - carbon monoxide, NOx - nitrogen oxides, VOC - volatile organic compounds, SOx - sulfur oxides, PM_{10} - particulates <10 microns.

See "Aircraft Source Information" tab for additional documentation of engine type, # of engines, flight mode, fuel flow, and emissions factors.

FALLON RANGE TRAINING COMPLEX EIS AIR POLLUTANT EMISSIONS CALCULATIONS - AIRCRAFT

Platform	CRITERIA AIR POLLUTANT EMISSIONS (tons/year)														
	No-Action Alternative					Alternative 1					Alternative 2				
	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}
Fixed-Wing															
A-10	0.1	0.3	0.0	0.0	0.1	0.2	0.3	0.0	0.1	0.1	0.2	0.4	0.0	0.1	0.1
AV-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C-130	0.3	1.5	0.0	0.2	0.2	0.4	1.6	0.1	0.2	0.2	0.4	1.8	0.1	0.2	0.2
EA-6B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA-18G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EP-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-5	34.2	3.8	1.3	2.1	7.5	54.7	6.0	2.0	3.4	11.9	60.2	6.6	2.2	3.7	13.1
F-15	0.1	2.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-16	0.0	0.0	0.0	0.0	0.0	1.2	104.8	1.0	2.4	2.4	1.3	115.3	1.1	2.7	2.7
FA-18	23.2	475.5	5.2	66.4	211.5	16.5	337.8	3.7	47.2	150.2	18.1	371.5	4.0	51.9	165.2
F-21	1.6	0.1	0.2	0.1	0.4	1.7	0.1	0.3	0.1	0.5	1.8	0.1	0.3	0.1	0.5
F-22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35	0.0	0.0	0.0	0.0	0.0	12.1	87.7	0.4	20.8	1.3	13.4	96.6	0.4	22.9	1.5
KC-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KC-130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KC-135	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OV-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-3C/P-8 MMA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RC-135	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T-34	0.0	0.2	0.0	0.1	0.1	0.0	0.3	0.0	0.1	0.2	0.0	0.3	0.0	0.1	0.2
Total	59.6	483.5	6.9	69.0	219.8	86.80	538.74	7.42	74.22	166.84	95.48	592.66	8.16	81.66	183.52
Rotary Aircraft															
AH-1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
AH-64	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
CH-46	1.0	0.2	0.2	0.1	0.1	1.1	0.3	0.2	0.1	0.1	1.2	0.3	0.2	0.1	0.1
CH-47	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
CH-53	0.1	0.3	0.0	0.1	0.1	0.1	0.4	0.0	0.1	0.1	0.1	0.4	0.0	0.1	0.1
H-60	6.6	7.6	0.7	2.4	4.9	7.0	8.1	0.8	2.5	5.2	7.7	8.9	0.9	2.8	5.7
MV-22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	7.9	8.4	1.0	2.7	5.2	8.39	8.97	1.04	2.84	5.52	9.23	9.85	1.15	3.12	6.07
Unmanned Aerial Systems															
RQ-7B	0.02	0.03	0.04	0.00	0.00	0.02	0.03	0.04	0.00	0.00	0.02	0.03	0.04	0.00	0.00
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grand Total	67.5	491.9	7.9	71.7	225.0	95.2	547.7	8.5	77.1	172.4	104.7	602.5	9.3	84.8	189.6
Change						27.7	55.8	0.6	5.4	-52.7	37.2	110.6	1.4	13.1	-35.4

Notes: CO - carbon monoxide, NOx - nitrogen oxides, VOC - volatile organic compounds, SOx - sulfur oxides, PM_{10} - particulate < 10 microns

FALLON RANGE TRAINING COMPLEX EIS AIR POLLUTANT EMISSIONS CALCULATIONS - AIRCRAFT

Platform	No Action Alternative					
	Annual Fuel Use		Greenhouse Gas Emissions (pounds/year)			
	Pounds	Gallons	CO_2	N_2O (excluded per AESO Memo 2012-02)	CH_4 (excluded per AESO Memo 2012-02)	CO_{2-e}
Fixed-Wing						
A-10	1,452,480	213,600	4,591,332			4,591,332
AV-8	41,405	6,089	130,882			130,882
B-52	119,040	17,506	376,289			376,289
C-130	918,192	135,028	2,902,432			2,902,432
EA-6B	19,890,571	2,925,084	62,874,681			62,874,681
EA-18G	9,304,200	1,368,265	29,410,850			29,410,850
E-2	4,577,760	673,200	14,470,434			14,470,434
EP-3	115,200	16,941	364,151			364,151
F-5	20,603,520	3,029,929	65,128,333			65,128,333
F-15	929,184	136,645	2,937,178			2,937,178
F-16	22,763,988	3,347,645	71,957,636			71,957,636
FA-18	429,805,451	63,206,684	1,358,627,673			1,358,627,673
F-21	523,669	77,010	1,655,334			1,655,334
F-22	36,990	5,440	116,926			116,926
F-35	0	0	0			0
KC-10	532,926	78,371	1,684,595			1,684,595
KC-130	22,500	3,309	71,123			71,123
KC-135	464,976	68,379	1,469,803			1,469,803
OV-10	30,960	4,553	97,865			97,865
P-3C/P-8 MMA	1,344,000	197,647	4,248,424			4,248,424
RC-135	277,344	40,786	876,693			876,693
T-34	180,706	26,574	571,216			571,216
Total						**1,624,563,847**
Rotary Aircraft						
AH-1	15590.4	2293	49282			49,282
AH-64	18259.2	2685	57718			57,718
CH-46	118800	17471	375530			375,530
CH-47	21385.62	3145	67601			67,601
CH-53	88200	12971	278803			278,803
H-60	2445972	359702	7731789			7,731,789
MV-22	10620	1562	33570			33,570
Total						**8,594,293**
Unmanned Aerial Systems						
RQ-7B	70	10	6,507			6,507
Total						**6,507**
Grand Total						**1,633,164,647**
					Metric Tons per Year =	**740,799**

Notes: CO_2 - carbon dioxide, N_2O - nitrous oxide, CH_4 - methane, CO_{2-e} - carbon dioxide equivalent

FALLON RANGE TRAINING COMPLEX EIS AIR POLLUTANT EMISSIONS CALCULATIONS - AIRCRAFT

Platform	Alternative 1					
	Annual Fuel Use		GHG Emissions (pounds/year)			
	Pounds	Gallons	CO_2	N_2O (excluded per AESO Memo 2012-02)	CH_4 (excluded per AESO Memo 2012-02)	CO_{2-e}
Fixed-Wing						
A-10	1,546,891	227,484	4,889,769			4,889,769
AV-8	46,580	6,850	147,242			147,242
B-52	119,040	17,506	376,289			376,289
C-130	980,232	144,152	3,098,542			3,098,542
EA-6B	0	0	0			0
EA-18G	35,247,411	5,183,443	111,418,103			111,418,103
E-2	4,874,760	716,876	15,409,260			15,409,260
EP-3	126,720	18,635	400,566			400,566
F-5	21,943,800	3,227,029	69,364,997			69,364,997
F-15	991,130	145,754	3,132,990			3,132,990
F-16	24,242,751	3,565,110	76,632,049			76,632,049
FA-18	305,316,558	44,899,494	965,114,620			965,114,620
F-21	558,388	82,116	1,765,080			1,765,080
F-22	41,100	6,044	129,918			129,918
F-35	0	0	0			430,188,384
KC-10	532,926	78,371	1,684,595			1,684,595
KC-130	22,500	3,309	71,123			71,123
KC-135	464,976	68,379	1,469,803			1,469,803
OV-10	32,895	4,838	103,982			103,982
P-3C/P-8 MMA	1,440,000	211,765	4,551,882			4,551,882
RC-135	277,344	40,786	876,693			876,693
T-34	192,211	28,266	607,585			607,585
Total						**1,691,433,470**
Rotary Aircraft						
AH-1	16,565	2,436	52,362			52,362
AH-64	19,781	2,909	62,528			62,528
CH-46	126,000	18,529	398,290			398,290
CH-47	21,386	3,145	67,601			67,601
CH-53	94,500	13,897	298,717			298,717
H-60	2,605,740	383,197	8,236,821			8,236,821
MV-22	10,620	1,562	33,570			33,570
Total						**9,149,888**
Unmanned Aerial Systems						
RQ-7 Shadow	75	11	6,931			6,931
Total						**6,931**
Grand Total (lb)						**1,700,590,289**
					Metric Tons	**771,383**
Increase (lb):						**67,425,642**
Increase (metric tons)						**30,584**

FALLON RANGE TRAINING COMPLEX EIS AIR POLLUTANT EMISSIONS CALCULATIONS - AIRCRAFT

Platform	Alternative 2					
	Annual Fuel Use		GHG Emissions (pounds/year)			
	Pounds	Gallons	CO_2	N_2O (excluded per AESO Memo 2012-02)	CH_4 (excluded per AESO Memo 2012-02)	CO_{2-e}
Fixed-Wing						
A-10	1,699,402	249,912	5,371,858			5,371,858
AV-8	46,580	6,850	147,242			147,242
B-52	148,800	21,882	470,361			470,361
C-130	1,079,496	158,749	3,412,319			3,412,319
EA-6B	0	0	0			0
EA-18G	38,767,500	5,701,103	122,545,208			122,545,208
E-2	5,361,840	788,506	16,948,934			16,948,934
EP-3	138,240	20,329	436,981			436,981
F-5	24,135,552	3,549,346	76,293,190			76,293,190
F-15	1,084,048	159,419	3,426,708			3,426,708
F-16	26,662,545	3,920,963	84,281,089			84,281,089
FA-18	335,848,214	49,389,443	1,061,626,082			1,061,626,082
F-21	613,358	90,200	1,938,844			1,938,844
F-22	45,210	6,649	142,910			142,910
F-35	0	0	0			473,513,770
KC-10	710,568	104,495	2,246,126			2,246,126
KC-130	22,500	3,309	71,123			71,123
KC-135	542,472	79,775	1,714,770			1,714,770
OV-10	35,798	5,264	113,157			113,157
P-3C/P-8 MMA	1,574,400	231,529	4,976,725			4,976,725
RC-135	346,680	50,982	1,095,866			1,095,866
T-34	211,838	31,153	669,627			669,627
Total						**1,861,442,889**
Rotary Aircraft						
AH-1	18,514	2,723	58,522			58,522
AH-64	21,302	3,133	67,338			67,338
CH-46	138,600	20,382	438,119			438,119
CH-47	24,950	3,669	78,867			78,867
CH-53	100,800	14,824	318,632			318,632
H-60	2,866,314	421,517	9,060,503			9,060,503
MV-22	10,620	1,562	33,570			33,570
Total						**10,055,550**
Unmanned Aerial Systems						
RQ-7B	82	12	7,547			7,547
Total						**7,547**
Grand Total (lb)	**0**	**0**				**1,871,505,986**
					Metric Tons	**848,910**
Increase (lb):						**238,341,338**
Increase (metric tons)						**108,111**

Alternative	Annual Flight Time (hrs)	Annual Flight Emissions (tons)					
		CO_{2e}	CO	NO_x	VOC	SO_2	PM
No Action Alternative	0	-	-	-	-	-	-
Alternative 1	2,210.25	215,094	12.15	87.72	< 0.397	20.79	1.33
Alternative 2	2,432.85	236,757	13.37	96.55	< 0.437	22.88	1.47

NOTE -- Criteria emissions are those below the mixing height. For global warming analysis, CO_2 equivalent (CO_{2e}) emissions include emissions above and below the mixing height.

These assumptions are used to compute CO_{2e}, SO_2, and PM emissions.

$EICO_2$ (eq.)	*EICO 2*	3,197 lb/1000 lb fuel
Percentage of sulfur in fuel (w/w)	*Sulfur_Content*	0.103 %
$EISO_2$	*EISO 2*	2.060 lb/1,000 lb fuel
Sulfur to PM Conversion Factor, from FOA3.0	*S_PM_Conversion*	150
Knot to ft/min Conversion Factor	*fpm_per_kt*	101 ft/s per kt

CV F-35C with F135 Engine

Key assumptions/Factors

1) The air speed was assumed to be 300 knots, altitude was assumed to be 6,934 ft above sea level, and power setting is 40% engine thrust rating (ETR). Except for CO_2 equivalent emissions, only emissions in the mixing layer assumed to be 15% of the total F-35 flight hours are calculated. Equivalent CO_2 emissions are calculated for total F-35 flight hours.

2) F135 fuel flow rates are interpolated from spreadsheet titled (T3 Card Deck F135 Sept 09.xls), from David Drye, received 28 September 2009. The minimum efficient engine fuel flows were used for this analysis. Interpolation based on altitude, airspeed, and % Engine Thrust Level (ETR) data from the source in note (1).

3) CO_2 equivalent emission indexes from EIA spreadsheet (Fuel Emission Factors.xls) downloaded from EIA web site (www.eia.doe.gov/oiaf/1605/excel/Fuel Emission Factors.xls), and JP-8 fuel densities from Bowden, J.N., Westbrook, S.R. and LePera, M.E., "A Survey of JP-8 and JP-5 Properties, Interim Report BFLRF No. 253", Accession Number: AD-A207 721, September 1988.

4) F135 CO, NOx and HC emission indexes are based on curve fits to spreadsheet titled "F135 Selected Parms all 5 Horiz positions," attached to email from Jean Hawkins, JSFPO, to Flint Webb, SAIC, subject "*FOUO - Proprietary Emissions Data - Export Controlled*," sent November 28, 2007. EIs are based on curve fits of combustor exit temperature (T3). HC emissions data was very low and highly variable so the EI curve fit was based on the two highest values rather than curve fitting all the data as a result the emissions are listed as being less than values. Emission indexes are calculated using the T3 data from (T3 Card Deck F135 Sept 09.xls) (note 5).

5) SO_2 emissions index based on all sulfur being emitted as SO_2 and an assumed sulfur content of 0.083% by weight for JP-8 from the Navy Aircraft Environmental Support, AESO Memorandum Report No 2012-01B "Sulfur Dioxide Emission Index Using JP-5 and JP-8", March 2013. The recommended sulfur content for 2011 was used for this analysis. Besides being used for calculating SO_2 emissions the sulfur content is also used to calculate sulfate particulate emissions as discussed in Note 6 below.

6) F135 non-After Burner (AB) PM emission indexes calculated as a sum of volatile and soot emissions. Volatile PM emissions are computed using the First Order Approximation version 3 (FOA3) approach described in "Methodology to Estimate Particulate Matter Emissions from Certified Aircraft Engines", Wayson, Fleming and Iovinelli, J. Air & Waste Management Association 59.91-100, January 2009. The methodology uses the HC EI, power setting, and the fuel sulfur content to compute the volatile component of EI PM. Test data indicates that PM emissions are generally smaller than 2.5 microns in aerodynamic diameter. A sulfur to sulfate conversion ratio of 5% is used per EPA mandate found in EDMS User's Manual Rev-7 - 11/06/09.

7) F135 Soot EI based on test data from "Quick Look PM Emission Study of a Prototype F-135 Gas Turbine Engine". Whitfield and Howard, under contract N00421-06-D-0010/0001, September 2006. The average value for each power setting was used to calculate the soot PM based on interpretation of plotted data.

8) Fuel used = fuel flow x time-in-mode / 60

9) Emissions = emission index x fuel used / 1,000

NO ACTION ALTERNATIVE

							Emissions Factors [4]							Total Pounds Annually						
Type of Operation	Total Number of Operations [1]	Power Setting (bhp) [2]	# Engines	Fuel Flow Rate (lb/bhp)/hr	Time in Mode (hr) [3]	Total Fuel Consumed (lb/op)	VOC lb/hp-hr	CO lb/hp-hr	NO_x lb/hp-hr	SO_2 lb/hp-hr	PM_{10} lb/hp-hr	$PM_{2.5}$ lb/hp-hr	CO_2 g/gal [5]	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_{2e}
RQ-7B Shadow Cruise	169	35	1	0.52	0.8	14.56	0.015	0.00696	0.011	0.000591	0.000721	0.0007	8320	70.98	32.93	52.05	2.80	3.41	3.31	6,507.24
												Total in Tons/Year		0.04	0.02	0.03	0.00	0.00	0.00	
												Total in Metric Tons/Year								2.95

[1] NAA annual ops from Table 2-6

[2] Engine data from AR741 Spec Sheet from www.uavenginesltd.co.uk

[3] Time in mode estimated based on Table 2-6 flight time.

[4] AP 42, Fifth Edition, Volume 1, Chapter 3, Table 3.3-1 Emissions Factors for Uncontrolled Gasoline and Diesel Industrial Engines. 1996

[5] Emission Factor from Mobile Combustion Sources (EPA 2008), Table B-2.

ALTERNATIVE 1

							Emissions Factors [4]							Total Pounds Annually						
Type of Operation	Total Number of Operations [1]	Power Setting (bhp) [2]	# Engines	Fuel Flow Rate (lb/bhp)/hr	Time in Mode (hr) [3]	Total Fuel Consumed (lb/op)	VOC lb/hp-hr	CO lb/hp-hr	NO_x lb/hp-hr	SO_2 lb/hp-hr	PM_{10} lb/hp-hr	$PM_{2.5}$ lb/hp-hr	CO_2 g/gal [5]	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_{2e}
RQ-7B Shadow Cruise	180	35	1	0.52	0.8	14.56	0.015	0.00696	0.011	0.000591	0.000721	0.0007	8320	70.98	32.93	52.05	2.80	3.41	3.31	6,930.79
												Total in Tons/Year		0.04	0.02	0.03	0.00	0.00	0.00	
												Total in Metric Tons/Year								3.14

[1] Alt 1 annual ops from Table 2-6

[2] Engine data from AR741 Spec Sheet from www.uavenginesltd.co.uk

[3] Time in mode estimated based on Table 2-6 flight time.

[4] AP 42, Fifth Edition, Volume 1, Chapter 3, Table 3.3-1 Emissions Factors for Uncontrolled Gasoline and Diesel Industrial Engines. 1996

[5] Emission Factor from Mobile Combustion Sources (EPA 2008), Table B-2.

ALTERNATIVE 2

							Emissions Factors [4]							Total Pounds Annually						
Type of Operation	Total Number of Operations [1]	Power Setting (bhp) [2]	# Engines	Fuel Flow Rate (lb/bhp)/hr	Time in Mode (hr) [3]	Total Fuel Consumed (lb/op)	VOC lb/hp-hr	CO lb/hp-hr	NO_x lb/hp-hr	SO_2 lb/hp-hr	PM_{10} lb/hp-hr	$PM_{2.5}$ lb/hp-hr	CO_2 g/gal [5]	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_{2e}
RQ-7B Shadow Cruise	196	35	1	0.52	0.8	14.56	0.015	0.00696	0.011	0.000591	0.000721	0.0007	8320	70.98	32.93	52.05	2.80	3.41	3.31	7,546.86
												Total in Tons/Year		0.04	0.02	0.03	0.00	0.00	0.00	
												Total in Metric Tons/Year								3.42

[1] Alt 2 annual ops from Table 2-6

[2] Engine data from AR741 Spec Sheet from www.uavenginesltd.co.uk

[3] Time in mode estimated based on Table 2-6 flight time.

[4] AP 42, Fifth Edition, Volume 1, Chapter 3, Table 3.3-1 Emissions Factors for Uncontrolled Gasoline and Diesel Industrial Engines. 1996

[5] Emission Factor from Mobile Combustion Sources (EPA 2008), Table B-2.

FALLON RANGE TRAINING COMPLEX EIS AIR POLLUTANT EMISSIONS CALCULATIONS - SOURCE INFORMATION

Platform	Engine	# Engines	Flight Mode	Fuel Flow/Engine (pounds per hour)	Fuel Flow (lbs/hr)	References for Fuel Flow and Emissions Factors	Notes	HC	Conversion Factor HC to VOC	VOC	VOC Notes
Fixed-Wing Aircraft											
A-10	TF34-GE-100-100A	2	military	3,026	6,052	USAF 2003 Draft Mobile AEI Guide Updated	*Assume A-10A/B*	N/A	N/A	0.40	No conversion required. Reported as VOC.
AV-8B	F402-RR-408	1	cruise	4,313	4,313	AESO Memorandum Report No. 9963, Revision C, November 2009		0.88	1.334	1.17	Ref: 9912, 6-90 (page 8)
B-52	TF33-P-3/103	8	military	7,440	59,520	USAF 2003 Draft Mobile AEI Guide Updated	*Assume B-52H*	N/A	N/A	0.55	No conversion required. Reported as VOC.
C-130	T56-A-9	4	Intermediate Military	2,068	8,272	USAF 2003 Draft Mobile AEI Guide Updated	*Assume C-130A*	N/A	N/A	0.35	No conversion required. Reported as VOC.
EA-6B	J52-P-408A	2	missile firing approach	4,227	8,454	AESO Memorandum Report No. 9941, Revision B, December 2009		0.84	1.15	0.97	Ref: 6-90 of T56-A-16 engine, 9908B, 9943C
EA-18G	F414-GE-400	2	circle	5,169	10,338	AESO Memorandum Report No. 9933, Revision D, March 2011	*Same engine as F/A-18E/F*	0.12	1.334	0.16	Ref: 2003-01, 9933D
E-2C	T56-A-425, -427	2	circle	1,100	2,200	AESO Memorandum Report No. 9943, Revision C, February 2010	*Assume E-2C, E-2C+*	0.49	1.15	0.56	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
EP-3	T56-A-14	4	missile firing approach	1,600	6,400	AESO Memorandum Report No. 9948, Revision C, March 2010		0.25	1.15	0.29	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
F-5	J85-GE-21	2	circle	1,752	3,504	AESO Memorandum Report No. 9944, Revision B, May 2013	*Assume F-5N*	1.12	1.1046	1.24	Ref: Procedures for Emission Inventory Preparation, Vol IV: Mobile Sources, EPA420-R-92-009, December 1992 (Page 198)
F-15	F100-PW-220	2	military	9,679	19,358	USAF 2003 Draft Mobile AEI Guide Updated	*Assume F-15C/D/E*	N/A	N/A	1.79	No conversion required. Reported as VOC in USAF 2003 Draft Mobile AEI Guide Updated.
F-16	F100-PW-229	1	military	11,490	11,490	USAF 2003 Draft Mobile AEI Guide Updated	*Assume F-16C/D*	N/A	N/A	0.54	No conversion required. Reported as VOC.
FA-18	F414-GE-400	2	circle	5,169	10,338	AESO Memorandum Report No. 9933, Revision D, March 2011	*Assume F/A-18E/F*	0.12	1.334	0.16	AESO recommended conversion factor applied for conversion from HC reported as unburned fuel to VOC
F-21	IAI Bedek-built GE J-79-J1E turbojet	1	Bombing circle	2,411	2,411	AESO Memorandum Report No. 2013-08, September 2013	*F-21A Kfir*	5.45	1.15	6.27	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
F-22	F119-PW-100	2	approach	1,370	2,740	USAF 2002 Aircraft/Auxiliary Power Units/ Aerospace Ground Support Equipment Emissions Factors	*Assume F-22A*	0.34	1.334	0.45	Ref: Aircraft/Auxiliary Power Units/Aerospace Ground Support Equipment Emission Factors (page 43)
F-35						See JSF Tab for Source Information	*Data obtained from JSF office*			JSF	JSF Tab
KC-10	F103-GE-101	3	military	19,738	59,214	USAF 2003 Draft Mobile AEI Guide Updated	*Assume KC-10A*	N/A	N/A	0.60	No conversion required. Reported as VOC.
KC-130	T56-A-16 Turboprop	4	circle	1,125	4,500	AESO Memorandum Report No. 2000-10 Revision B, January 2001	*Assume KC-130F/R/T*	0.47	1.15	0.54	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
KC-135	F108-CF-100	4	military	6,458	25,832	USAF 2003 Draft Mobile AEI Guide Updated	*Assume KC-135R*	N/A	N/A	0.30	No conversion required. Reported as VOC in USAF 2003 Draft Mobile AEI Guide Updated.

FALLON RANGE TRAINING COMPLEX EIS AIR POLLUTANT EMISSIONS CALCULATIONS - SOURCE INFORMATION

Platform	Engine	# Engines	Flight Mode	Fuel Flow/Engine (pounds per hour)	Fuel Flow (lbs/hr)	References for Fuel Flow and Emissions Factors	Notes	HC	Conversion Factor HC to VOC	VOC	VOC Notes
OV-10	Garrett T76-G-410/412 Turboprop	2	cruise	194	387	USEPA 1971 Exhaust Emissions Tests		0.08	1.15	0.09	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC. EPA Exhaust Emissions Test.
P-3C/P-8 MMA	T56-A-14	4	missile firing approach	1,600	6,400	AESO Memorandum Report No. 9948, Revision C, March 2010		0.25	1.15	0.29	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
RC-135	TF33-P-5&9	4	military	9,630	38,520	USAF 2003 Draft Mobile AEI Guide Updated	*Assume RC-135S*	N/A	N/A	0.55	No conversion required. Reported as VOC.
T-34	PT6A-25	1	circle	376	376	AESO Memorandum Report No. 9952 Revision A, June 2010		0.12	1.334	0.16	AESO recommended conversion factor applied for conversion from HC reported as unburned fuel to VOC
Rotary											
AH-1	T700-GE-401C	2	circle	406	812	AESO Memorandum Report No 9961 Revision A, November 2009		0.57	1.15	0.66	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
AH-64	T700-GE-701C	2	circle	634	1,268	AESO Memorandum Report No. 9953 Revision B, June 2011	*Per AESO, it is the same engine as the T700-GE-401C.*	0.55	1.15	0.63	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
CH-46	T58-GE-16, -402	2	circle SPIERIG	600	1,200	AESO Memorandum Report No. 9959 Revision B, January 2001.	*For UH-46E, HH-46E, CH-46E, HH-46D & CH-46D*	2.64	1.15	3.04	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
CH-47	T55-GA-714A	2	circle SPIERIG	1,188.09	2,376	AESO Memorandum Report No. 2012-06, July 2012	*For CH-47SD, CH-47F, MH-47G, HH-47*	0.86	1.15	0.99	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC. Ref: 9905A, 2012-06.
CH-53	T64-GE-415	3	circle	1,400	4,200	AESO Memorandum Report No 9960 Revision C, November 2009		0.25	1.15	0.29	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC. Ref: 9905A, 9960C.
H-60	T700-GE-401C	2	circle	634	1,268	AESO Memorandum Report No. 9953 Revision C, January 2014	*Assume HH-60H/SH-60B & SH-60F*	0.55	1.15	0.63	AESO recommended conversion factor applied for conversion from HC reported as methane to VOC
MV-22	T406-AD-400	2	circle SPIERIG	1,770	3,540	AESO Memorandum Report No. 9965, Revision B, January 2001		0.01	1.334	0.01	AESO recommended conversion factor applied for conversion from HC reported as unburned fuel to VOC
Unmanned Aerial Systems											
RQ-7 Shadow	Wankel UAV Engine 741	1		0.52	1	Horsepower from manufacturer's fact sheet. AP-42 emissions factors used to estimate emissions based on horsepower. See RQ-7 Tab for Source Information.				RQ-7	RQ-7 Tab

OTHER ASSUMPTIONS

For UAS, assume all UAS are RQ-7B

For combined FA-18/F-35 row in Table 2-5, assume 1/3 are F-35 for Alt 1 and 2 based on the introduction rate mentioned in the DOPAA.

AESO Memorandum 2012-01C was the source for the sulfur dioxide emission index for JP-5 and JP-8 fuel used in Navy aircraft. Assume all USAF fuel is JP-8.

Assume $PM_{2.5}$ = PM_{10} per AESO Memorandum Report No. 2013-04 Revision A (January 2014). Assume 3.97 EF for PM_{10} unless otherwise provided by source document.

Assume power settings and time-in-mode of aircraft operations above 3,000 ft are the same as below 3,000 ft