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Subject: Whidbey Island Military Jet Noise Measurements

Ladies and Gentlemen:

This report summarizes my findings regarding the measured noise levels from military jet operations on Whidbey Island near Coupeville, WA. The noise measurements were conducted on May 7, 2013 at five locations near the touch and go landing strip (OLF Coupeville) approximately 3 miles southeast of Coupeville, WA. Figure 1 presents an aerial photograph showing the five measurement locations. These locations represent populated areas where people could be exposed to the aircraft noise without necessary hearing protection. The aircraft used in these operations were the EA-18G aircraft, which is replacing the older (and quieter) EA-6B jets.

Acoustic Instrumentation

The noise measurements were taken with two data logging sound level meters with current calibration certificates. The data from Positions 1, 2, and 3 were collected using a Bruel & Kjaer model 2270, and the data from Positions 4 and 5 were collected using a Bruel & Kjaer model 2238. Both instruments were programmed to record the A-weighted sound pressure level and the un-weighted (linear) sound pressure level every second. At each location the sound level meter was positioned on a tripod with the measurement microphone and protective windscreen positioned 5 feet above existing grade and away from nearby reflecting objects. Figure 2 presents a photograph of the B&K 2270 at Position 1 and the B&K 2238 at Position 4. Measurement Position 5 was an interior measurement with the noise monitoring system set up inside the living room of the residence.

Measurement Results

Figures 3 through 7 present the measured A-weighted and un-weighted peak (linear) sound pressure level as a function of time at each of the five measurement locations. The graph on the top half of each page is a plot of the 1-second average (L_{eq}) sound pressure level, and the graph on the bottom half of each page is a plot of the un-weighted peak (linear) sound pressure level for each second of the measurement. It should be noted that the A-weighted sound pressure level is always significantly less than the un-weighted peak sound pressure level. There are two reasons for this difference. First and foremost, the A-weighting filters out much of the low frequency noise. Second, each of the A-weighted data points represents an average over a full second, while the un-weighted data points represent the highest sound level during each second. The un-weighted peak sound pressure level is typically about 18 dB higher than the 1-second average (L_{eq}) A-weighted sound pressure level during the aircraft flyover sessions. Most outdoor noise criteria are based on the A-weighted sound pressure level, but some hearing damage criteria are based on the un-weighted peak sound pressure level, and that is why the un-weighted peak data is included in this report.

Table 1 presents the summary noise level statistics for these measurements. The highest noise levels occurred at Position 1, which is in a densely populated residential area 1 mile south of the south end of the OLF runway. The lowest noise levels were measured at Position 5, which is inside a relatively new private residence 0.9 miles west of the north end of the OLF runway. The first two rows in Table 1 show the maximum A-weighted and peak un-weighted (linear) sound pressure levels during the measured session at each measurement location. The third row presents the total sound exposure level (SEL) for the entire session of jet flyovers. The sound exposure level (SEL) represents the total acoustic energy in a noise event, and it depends not only on the level of the noise but also the duration of the noise. The duration of each session is presented in the 4th row.

Table 1. Noise level statistics at each measurement location.

Statistic	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5
Maximum A-weighted Level (dBA)	119.2	113.4	115.7	114.3	81.1
Maximum Un-Weighted Peak Level (dB)	134.2	126.7	130.6	131.4	101.8
Session SEL (dBA)	128.5	124.5	122.7	127.7	92.1
Session Duration (minutes)	39	58	45	36	25
Total Jet Flyovers	35	43	26	28	8
Average SEL per Jet Flyover (dBA)	113.1	108.2	108.5	113.2	83.1

Because the jets are so close together, there is not enough time for the noise level to return to the ambient noise level before the next jet arrives, so it is not possible to measure the SEL of each individual jet flyover. However, knowing the number of jets and the total SEL for the entire session, it is possible to calculate the average SEL for a single jet flyover at each location, and this is what is shown in the last row of Table 1.

Table 2 presents the total time (in seconds) that the A-weighted and un-weighted peak sound pressure levels were over the indicated sound level threshold at each measurement location for that measurement session. Note that the exposure times at Position 2 are greater than Position 1 for the 80 to 90 dBA and 100 to 110 dB (peak linear) ranges, while the opposite is true at the higher sound level ranges. This is because the jets are scattered over a wider area near Position 2, causing an increased distance from the jets to the measurement location at Position 2. At Position 1 the jets are in a much tighter area and at a lower altitude (to access the OLF runway), and the homes are at a higher elevation (due to the existing topography), resulting in a reduced distance from the jets to the measurement location at Position 1.

Table 2. Time over threshold statistics at each measurement location.

Statistic	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5
Total Time over 80 dBA (sec)	581	1,298	593	919	1
Total Time over 85 dBA (sec)	448	855	365	600	0
Total Time over 90 dBA (sec)	335	371	195	408	0
Total Time over 95 dBA (sec)	235	121	87	248	0
Total Time over 100 dBA (sec)	128	50	39	135	0
Total Time over 105 dBA (sec)	48	18	10	45	0
Total Time over 110 dBA (sec)	11	3	2	8	0
Total Time over 100 dB peak linear (sec)	501	1,299	464	861	6
Total Time over 105 dB peak linear (sec)	385	696	261	550	0
Total Time over 110 dB peak linear (sec)	279	227	125	332	0
Total Time over 115 dB peak linear (sec)	175	83	61	186	0
Total Time over 120 dB peak linear (sec)	87	31	29	83	0
Total Time over 125 dB peak linear (sec)	28	5	5	23	0
Total Time over 130 dB peak linear (sec)	8	0	2	3	0

Data Analysis

It is difficult to make a direct comparison of these measured results with noise level predictions from the March 2005 AICUZ Study prepared by The Onyx Group, because

that study did not present maximum noise levels from the military jet activities. That study did, however, show predicted calendar year 2013 annual average day-night sound level (L_{dn}) contours surrounding the OLF in Figure 7-6 of that report.

The average SEL for each jet flyover can be used to calculate the day-night average sound level (L_{dn}) knowing only the number of jet flyovers and the percentage of day vs. night flights. The day-night sound level (L_{dn}) can be calculated for a single day, and it can be calculated for an annual average by assuming a certain number of over-flights during the daytime and nighttime hours. It is extremely important to specify the ratio of daytime to nighttime flyovers, because of the time weighting factor used in the calculation of the day-night sound level. This weighting can best be understood by knowing that a single jet flyover at night (after 10 PM and before 7 AM) is exactly equal to 10 identical jet flyovers during the daytime hours.

Table 3 presents a summary of the calculated day-night sound levels for each measurement location as it compares with the predictions found in the March 2005 AICUZ Study. Position 5 is not shown in this table because the L_{dn} predictions represent exterior sound levels, and the measurements at this location were taken indoors. Note that the day-night average L_{dn} sound levels calculated from the noise measurements taken on 5/7/13 are all significantly higher than the levels predicted in the March 2005 AICUZ Study. There may be several reasons for this discrepancy, including aircraft type and percentage of nighttime flights, but the main reason has to do with the annual average. Because the jets do not fly every day, when you average the "noisy" days with the "quiet" days the L_{dn} values become lower (diluted).

Table 3. Calculated single-day L_{dn} noise level at the four outside measurement locations, derived from the 5/7/13 data set. The AICUZ projection is based on an annual average.

Statistic	Pos. 1	Pos. 2	Pos. 3	Pos. 4
AICUZ Study Predicted CY 2013	77	70	70	75
1 daytime session, 0 night sessions	79.2	75.2	73.3	78.3
2 daytime sessions, 0 night sessions	82.2	78.2	76.3	81.3
3 daytime sessions, 0 night sessions	84.0	79.9	78.1	83.1
4 daytime sessions, 0 night sessions	85.2	81.2	79.3	84.3
0 daytime sessions, 1 night session	89.2	85.2	83.3	88.3
3 daytime sessions, 1 night session	90.3	86.3	84.4	89.4
2 daytime sessions, 2 night sessions	**92.6**	**88.6**	**86.7**	**91.7**
1 daytime session, 3 night sessions	94.1	90.1	88.2	93.2

Table 4 presents the predicted average annual day-night sound levels due only to military jet operations at OLF Coupeville. In this analysis I have assumed that all jets are the EA-18G aircraft and the number of military jet over-flights is 4,834 per year at Position 1 (bounces using either path 14 or 32) and 3,784 at Positions 2 through 4 (bounces using path 32), which I understand to be the actual number of over-flights from 2012. The top row of Table 4 shows the predicted values from the 2005 AICUZ Study, which I understand assumed a total of 3,060 over-flights with only 16.8% occurring at night (after 10 PM). A range is shown because the values were taken from the noise contour map. The second row of Table 4 (shown bold) shows the calculated average annual L_{dn} assuming that 59% of the over-flights occur at night, which I understand represents the actual number for 2012. The other rows in the table show the calculated average annual L_{dn} for other percentages of nighttime flights.

Table 4. Predicted and calculated annual average L_{dn} at each measurement location.

Operational Assumptions	Pos. 1	Pos. 2	Pos. 3	Pos. 4
AICUZ Study Predicted CY 2013	76 to78	68 to 72	68 to 72	74 to 76
41% Day Sessions, 59% Night Sessions	**83.0**	**77.9**	**76.0**	**81.0**
90% Day Sessions, 10% Night Sessions	77.7	72.7	70.8	75.8
80% Day Sessions, 20% Night Sessions	79.4	74.4	72.5	77.5
70% Day Sessions, 30% Night Sessions	80.6	75.6	73.7	78.7
60% Day Sessions, 40% Night Sessions	81.6	76.5	74.6	79.7
50% Day Sessions, 50% Night Sessions	82.4	77.3	75.4	80.4
40% Day Sessions, 60% Night Sessions	83.0	78.0	76.1	81.1
30% Day Sessions, 70% Night Sessions	83.6	78.5	76.6	81.7
20% Day Sessions, 80% Night Sessions	84.1	79.0	77.1	82.2
10% Day Sessions, 90% Night Sessions	84.6	79.5	77.6	82.6

Clearly, averaging over an entire year yields a much lower noise level when the number of operational days is small compared to the number of "quiet" days. In my opinion, the community reaction is more likely to follow the single event statistics (SEL and maximum noise level, L_{max}) as opposed to the daily L_{dn}, and even less likely to follow the average annual L_{dn}. People can easily hear the SEL and L_{max}, but the daily L_{dn} and annual average L_{dn} statistics are nothing more than numbers to which most people cannot relate. The community noise surveys showing the relationship between L_{dn} and the percentage of people highly annoyed are based mostly on social surveys of people exposed to noise around commercial airports which have approximately the same number of operations every day. For that reason, it seems only logical to assess the expected

community reaction around Coupeville OLF on the average daily L_{dn} on fly days only, which would be the values presented in Table 3, not the values in Table 4.

I should also point out that the calculated day-night sound levels are well above recommended levels for residential areas. For example, in the 1980's the Port of Seattle purchased virtually all homes near Sea-Tac airport that were located inside the 75 L_{dn} contour, recognizing that aircraft noise above these levels are harmful to humans. The Port and the FAA is also funding multi-family residential building sound reduction projects for homes located inside the 65 L_{dn} contour. Clearly, these thresholds are well below the calculated L_{dn} levels shown in Tables 3 and 4.

Summary and Conclusions

The primary purpose for this study was to determine: (a) whether the 2005 AICUS noise contour projections are consistent with measured noise levels of the EA-18G aircraft operating at Coupeville OLF based on the actual number of over-flights in 2012, and (b) to determine whether noise levels in various positions around the OLF are below or above thresholds that should sponsor a need to examine possible impacts on the health and well-being of those exposed.

Clearly, the actual 2012 noise levels are much higher than predicted in the 2005 AICUZ Study, partly because of the greater number of over-flights, but primarily because of the much higher percentage of nighttime flights. The maximum sound levels are well above the levels requiring hearing protection and are high enough to potentially result in permanent hearing loss. These two facts alone lead me to conclude that the 2005 AICUZ Study should be revised and/or updated to more accurately reflect the potential noise impacts on the people living in the area.

If you have any questions regarding these findings, do not hesitate to give me a call.

Very truly yours,
JGL Acoustics, Inc,

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Figure 1. Aerial photograph showing the 5 noise measurement locations.

Figure 2. Photographs of sound level meter at Position 1 (above) and Position 4 (below).

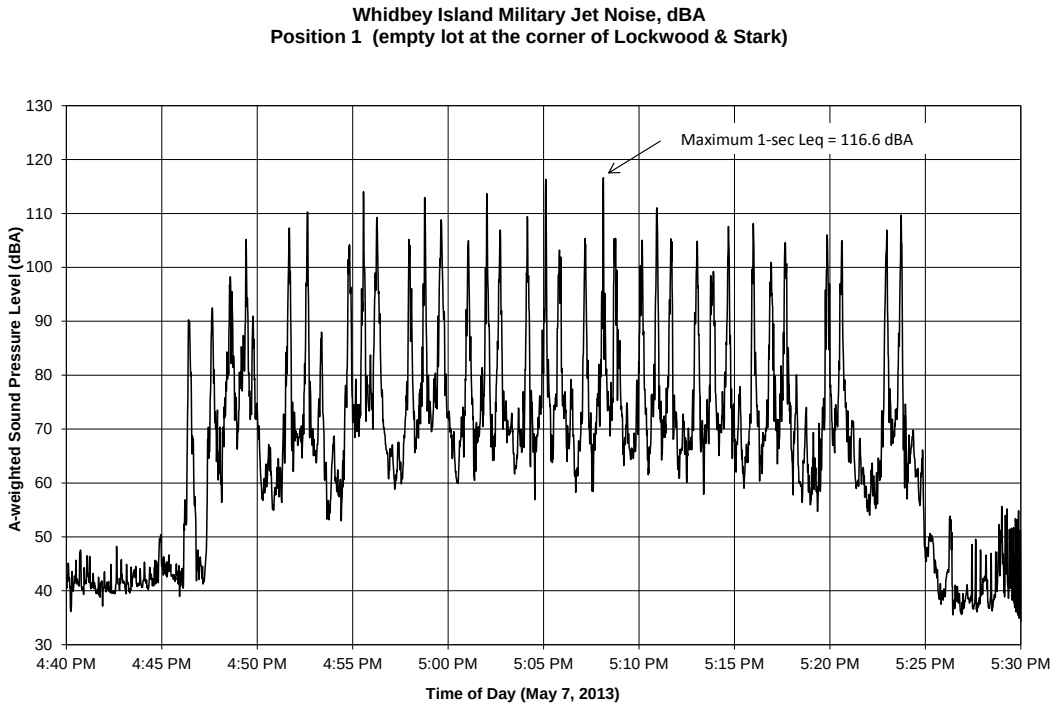
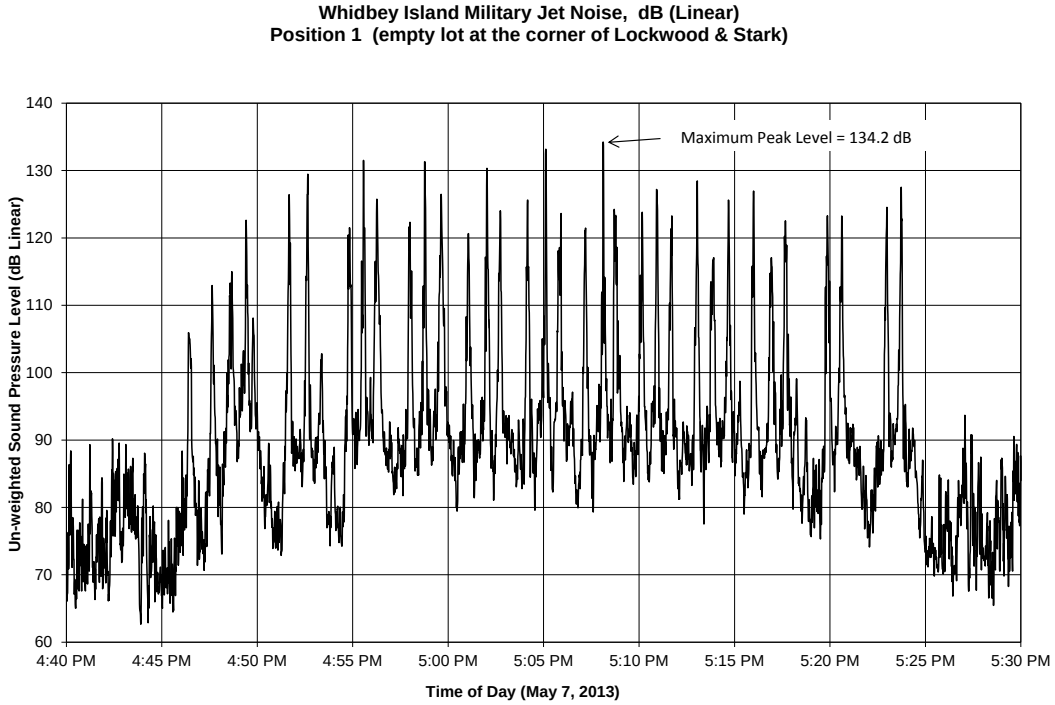


Fig. 3. Measured A-weighted (above) and un-weighted (below) noise levels at Position 1



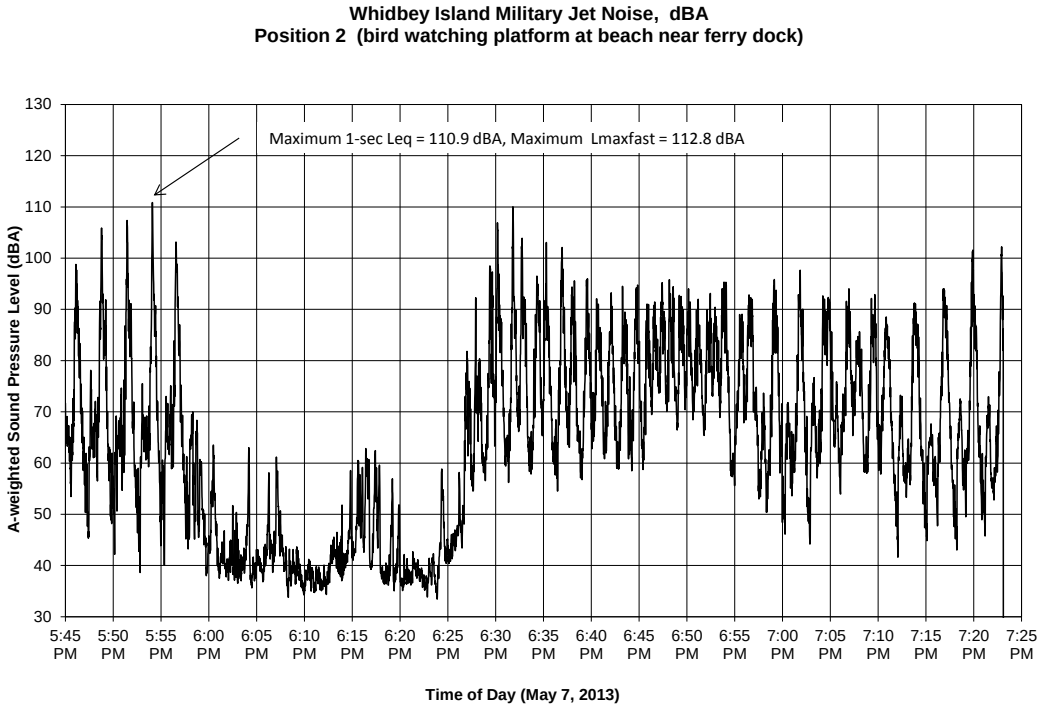
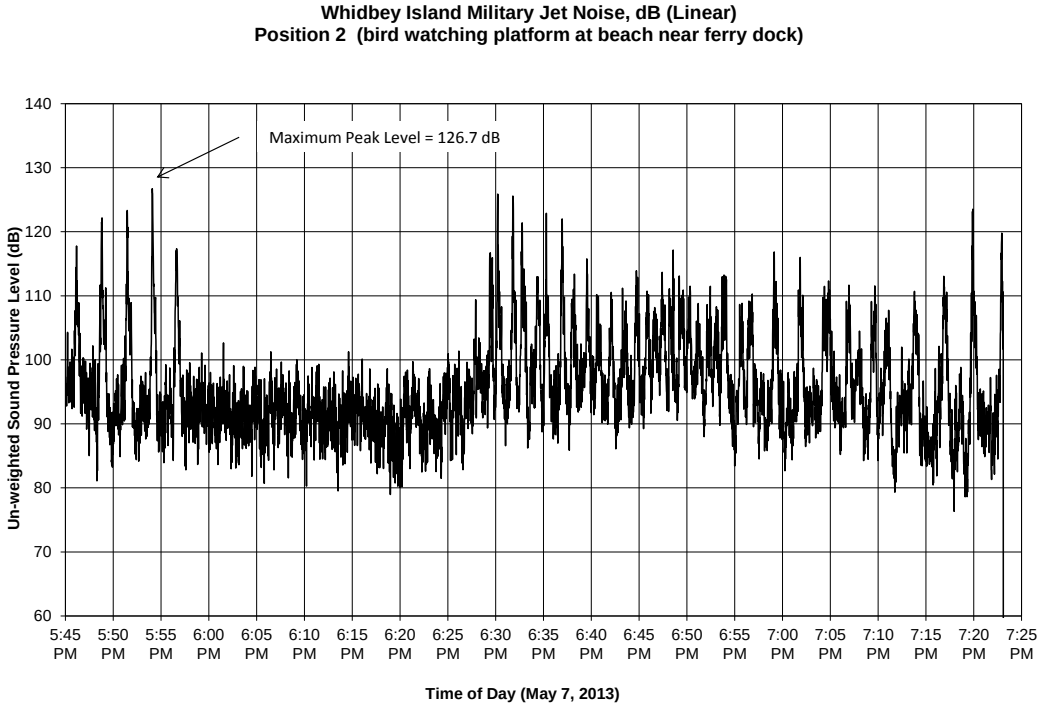


Fig. 4. Measured A-weighted (above) and un-weighted (below) noise levels at Position 2



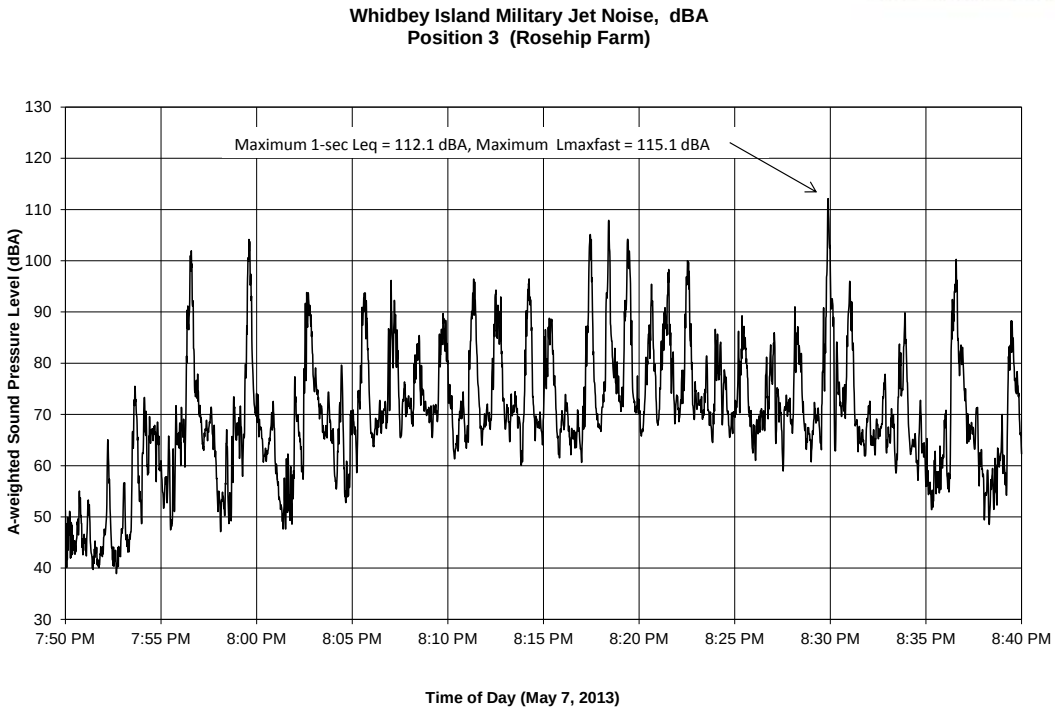
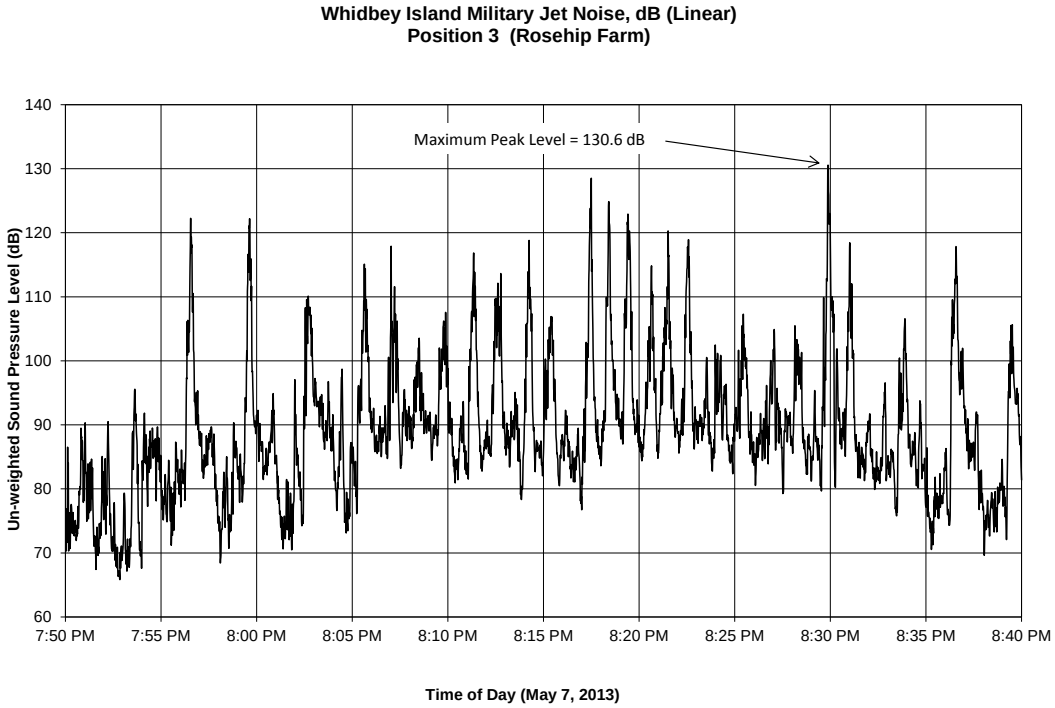


Fig. 5. Measured A-weighted (above) and un-weighted (below) noise levels at Position 3



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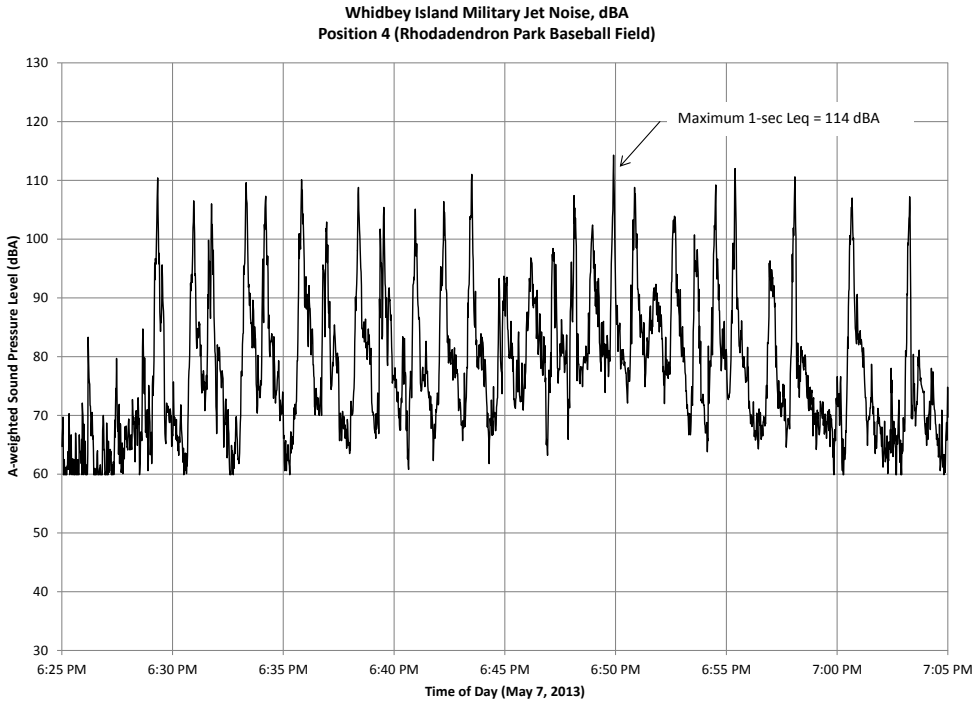
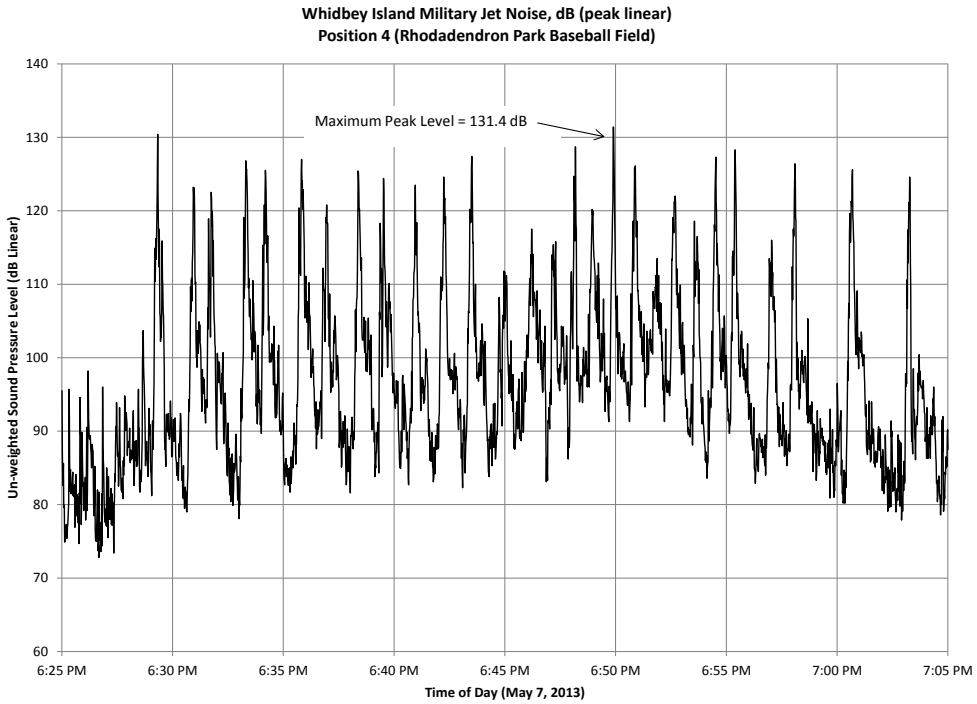


Fig. 6. Measured A-weighted (above) and un-weighted (below) noise levels at Position 4



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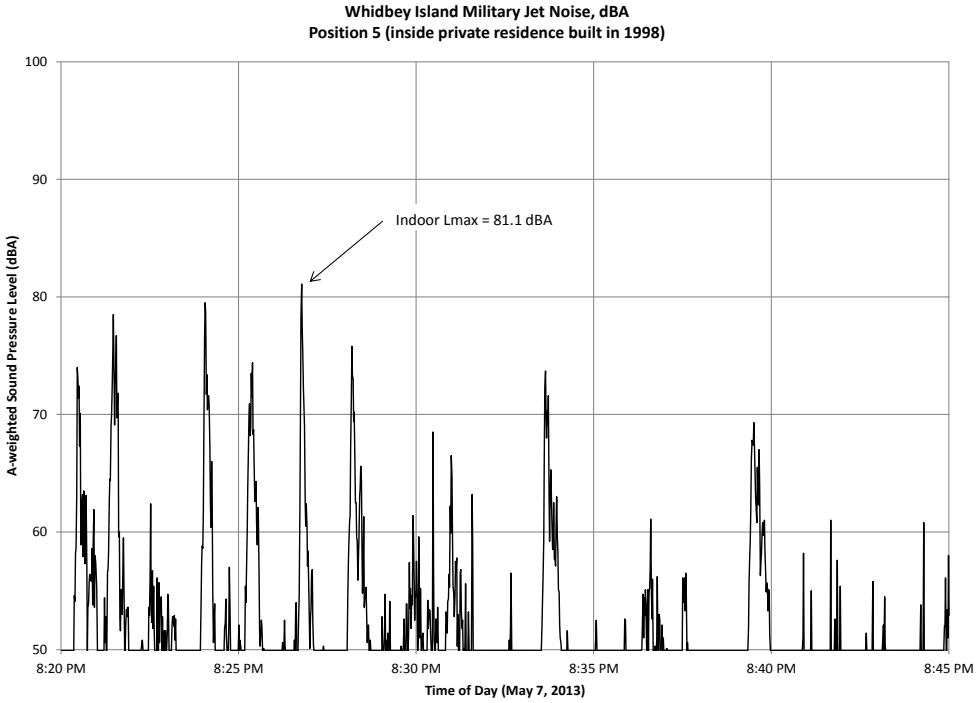
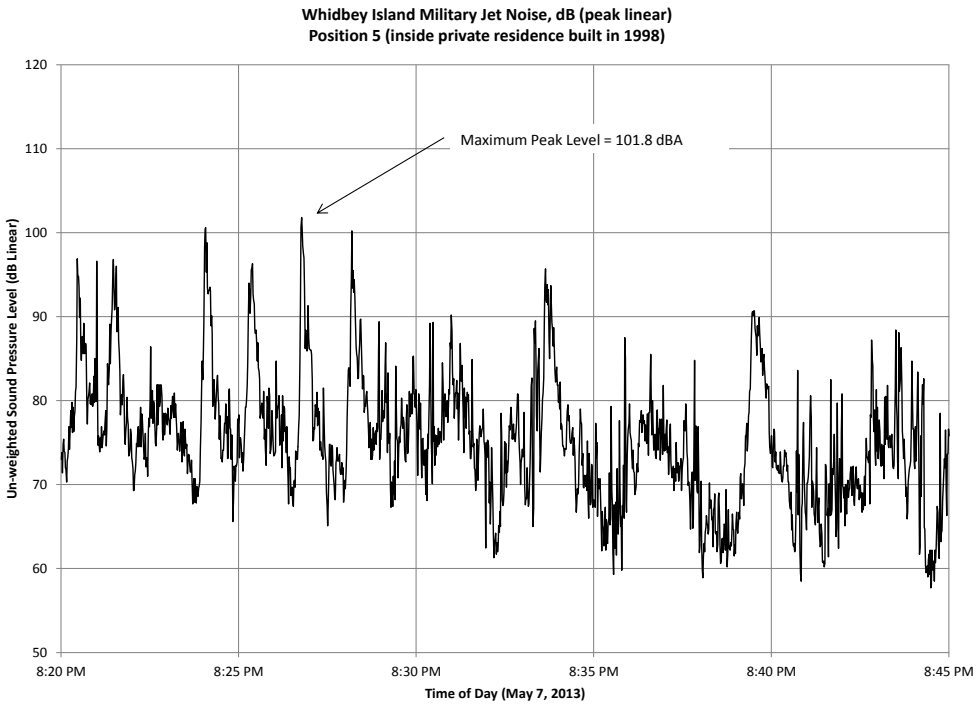


Fig. 7. Measured A-weighted (above) and un-weighted (below) noise levels at Position 5



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