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# **MOONIES HILL ENERGY**

## **FLAT ROCKS WIND FARM KOJONUP**

### **BACKGROUND NOISE MONITORING**

**FEBRUARY 2011**

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**BACKGROUND NOISE MONITORING**  
**KOJONUP**

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FOR

**MOONIES HILL ENERGY**

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## 1. INTRODUCTION

Herring Storer Acoustics were commissioned by Moonies Hill Energy to carry out background noise monitoring for the proposed Flat Rocks Wind Farm development area.

The proposed development site is located to the east of Albany Highway, approximately 260km southeast of Perth and 27km southwest of the township of Katanning in southwest Western Australia.

The proposed wind farm consists of approximately 74 wind turbines, in cleared wheat farming country.

Background noise monitoring was commissioned to enable the results to be used in the noise impact assessment, carried out in accordance with the following documentation;

- South Australia EPA – Wind Farm Environmental Noise Guidelines.
- Environmental Protection and Heritage Council National Wind farm Development Guidelines – Draft, July 2010 (Guidelines).
- Australian Standard 4959-2010 Acoustics – Measurement, prediction and assessment of noise from wind turbine generators.

This report presents the results of the monitoring and analysis.

## 2. SUMMARY

Based on the results of background noise monitoring within the proposed wind farm development area, the applicable criteria for each location is as listed in Table 2.1

**TABLE 2.1 – NOISE CRITERIA BASED ON BACKGROUND NOISE LEVELS, dB(A)**

Location	WIND SPEED AT 80m ABOVE GROUND LEVEL (m/s)						
	3	4	5	6	7	8	9
1	41	40	39	39	39	39	40
2	35	35	35	35	36	37	39
3	38	39	40	41	41	42	42
4	39	39	40	41	42	43	44
5	35	35	35	36	38	40	42
6	35	35	35	35	35	37	38
7	35	35	35	35	36	37	38
8	35	35	36	37	39	41	42
9	35	35	36	37	39	41	43
10	39	39	39	39	40	41	42
11	38	38	38	37	38	38	39

### 3. METHODOLOGY

Background noise levels were monitored at eleven locations within the proposed development area in accordance with the Guidelines and AS4959-2010. Locations are detailed in Table 3.1 the monitoring location map is attached in Appendix A.

**TABLE 3.1 – MONITORING LOCATION DETAILS**

Location	Easting	Northing
1	529821.51	6247170.85
2	530084.12	6245361.49
3	531662.22	6251702.58
4	533629.50	6245182.81
5	533298.59	6237261.63
6	534084.33	6239794.22
7	528558.48	6237293.21
8	536092.02	6244487.31
9	531649.59	6243477.22
10	532980.19	6242568.68
11	528913.34	6240557.08
Wind Monitor	531929.00	6241065

Monitored noise levels were then paired with corresponding wind data, provided by the wind monitoring station located within the development by Moonies Hill Energy (located at a height of approximately 80 metres above ground level – proposed hub height).

Rain affected data was removed from the collected data using weather information provided by the Department of Agriculture's Automatic Weather Station, located within the Kojonup district.

Background noise levels were plotted against the corresponding wind speed measurement (see Appendix C).

The relevant regression line providing the best correlation co-efficient for each location was determined (from linear to third order). The calculated regression line equations were then used to ascertain the background noise ( $L_{A90,10 \text{ minutes}}$ ) at each integer wind speed to determine the relevant noise criteria for the wind farm development, which should not exceed whichever is the greater of;

- 35 dB(A), or
- The background noise ( $L_{A90,10 \text{ minutes}}$ ) by more than 5 dB(A).

Calibration certificates for meters used are attached in Appendix E.

### 4. RESULTS

Background noise monitoring regression analysis results for each of the eleven locations is presented in Appendix C, with time history charts presented in Appendix D.

Refer to Appendix A and B for location information for each noise logger.

The calculated relevant regression line equations for each location are listed below;

**Monitoring Location 1**

$$y = 0.2205x^2 - 2.9087x + 43.064$$

**Monitoring Location 2**

$$y = 0.0626x^2 + 0.8502x + 21.587$$

**Monitoring Location 3**

$$y = -0.116x^2 + 1.9204x + 28.296$$

**Monitoring Location 4**

$$y = 0.0821x^2 - 0.2008x + 33.981$$

**Monitoring Location 5**

$$y = 0.046x^2 + 1.0933x + 23.062$$

**Monitoring Location 6**

$$y = 0.1251x^2 - 0.6306x + 28.632$$

**Monitoring Location 7**

$$y = 0.1057x^2 - 0.5569x + 29.642$$

**Monitoring Location 8**

$$y = 0.0519x^2 + 1.002x + 24.262$$

**Monitoring Location 9**

$$y = 0.0519x^2 + 1.0913x + 24.008$$

**Monitoring Location 10**

$$y = 0.1176x^2 - 0.9813x + 35.844$$

**Monitoring Location 11**

$$y = 0.121x^2 - 1.4273x + 36.677$$

It is noted that in the above equations,  $y = L_{A90}$  (dB(A)) and  $x$  = wind speed at 80 metres height (m/s).

Based on the above calculated regression lines, Table 4.1 summarises the background noise at each location for each integer wind speed.

**TABLE 4.1 – BACKGROUND NOISE LEVELS,  $L_{A90,10 \text{ minutes}}$  [dB(A)]**

Location	WIND SPEED AT 80m ABOVE GROUND LEVEL (m/s)						
	3	4	5	6	7	8	9
1	36	35	34	34	34	34	35
2	25	26	27	29	31	32	34
3	33	34	35	36	36	37	37
4	34	34	35	36	37	38	39
5	27	28	30	31	33	35	37
6	28	28	29	29	30	32	33
7	29	29	30	30	31	32	33
8	28	29	31	32	34	36	37
9	28	29	31	32	34	36	37
10	34	34	34	34	35	36	37
11	33	33	33	32	33	33	34

## 5. CRITERIA

The noise criteria for new wind farm developments, based on the Guidelines, is for the predicted noise level to not exceed whichever is the greater of;

- 35 dB(A) or,
- the background noise ( $L_{A90,10 \text{ minute}}$ ) by more than 5 dB(A).

Hence the applicable criteria for the proposed wind farm development based on the background noise monitoring are listed below in Table 5.1.

**TABLE 5.1 – NOISE CRITERIA BASED ON BACKGROUND NOISE LEVELS, dB(A)**

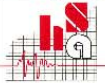
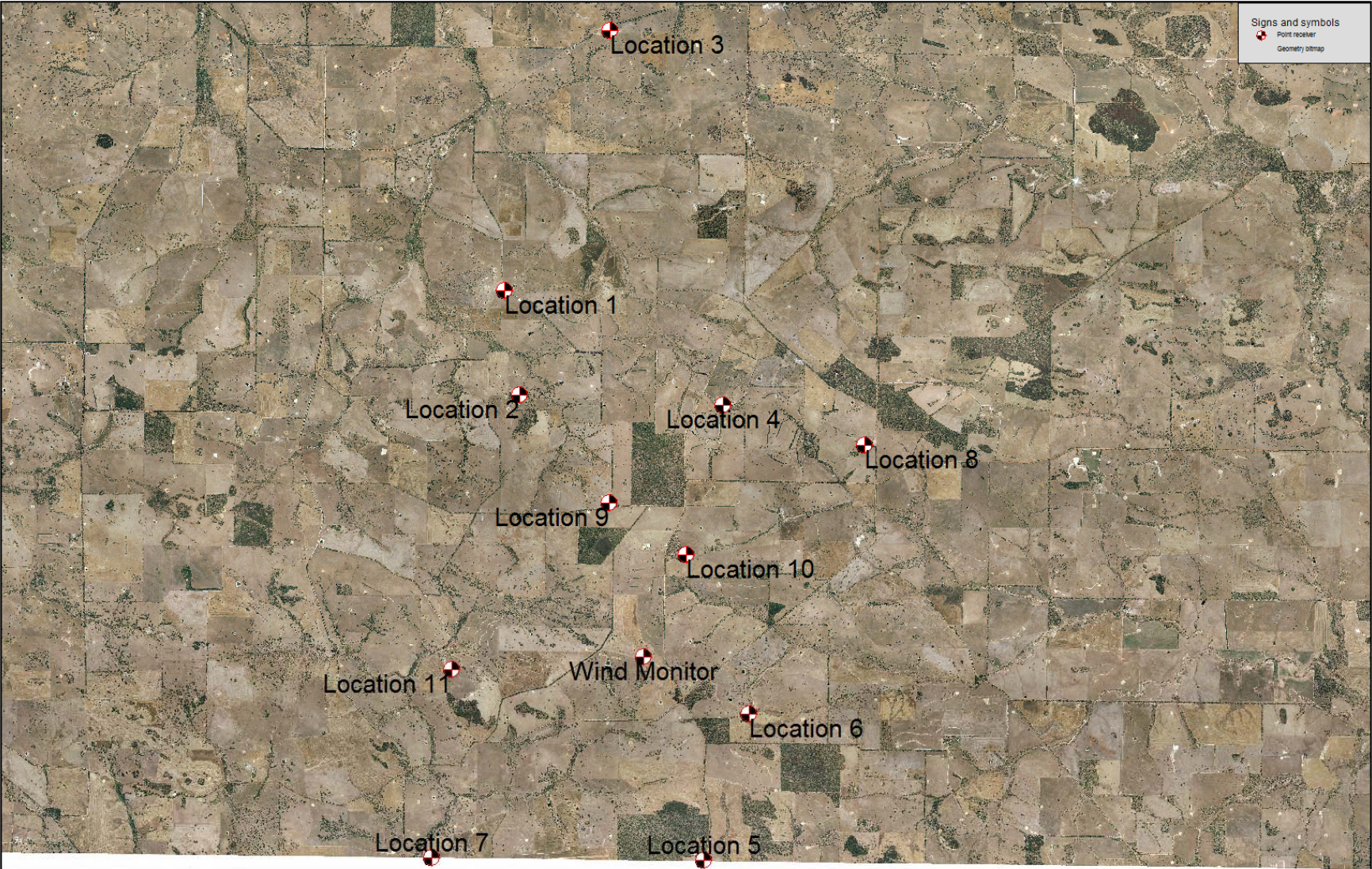
Location	WIND SPEED AT 80m ABOVE GROUND LEVEL (m/s)						
	3	4	5	6	7	8	9
1	41	40	39	39	39	39	40
2	35	35	35	35	36	37	39
3	38	39	40	41	41	42	42
4	39	39	40	41	42	43	44
5	35	35	35	36	38	40	42
6	35	35	35	35	35	37	38
7	35	35	35	35	36	37	38
8	35	35	36	37	39	41	42
9	35	35	36	37	39	41	43
10	39	39	39	39	40	41	42
11	38	38	38	37	38	38	39

It is noted that the noise criteria has been referenced to wind speeds at the proposed wind turbine generator hub height (80m), as stated in AS 4959-2010. This ensures a conservative result in the determination of the noise criterion, as the hub height wind speeds are generally higher than those at 1.5m above ground level (microphone height), which results in measured noise levels being related to those that are higher than what is being encountered at microphone height.

This can be visually observed in the charts contained in Appendix C, where at some locations there is a large number of low noise data points at all windspeeds (at 80m). This can be explained by the low wind speeds at microphone height compared to the high wind speeds at the proposed hub height.

# **APPENDIX A**

## MONITORING LOCATIONS



# **APPENDIX B**

## **MONITORING LOCATION DETAILS**

## Location 1



## Location 2



## Location 3



## Location 4



## Location 5



## Location 6



## Location 7



## Location 8



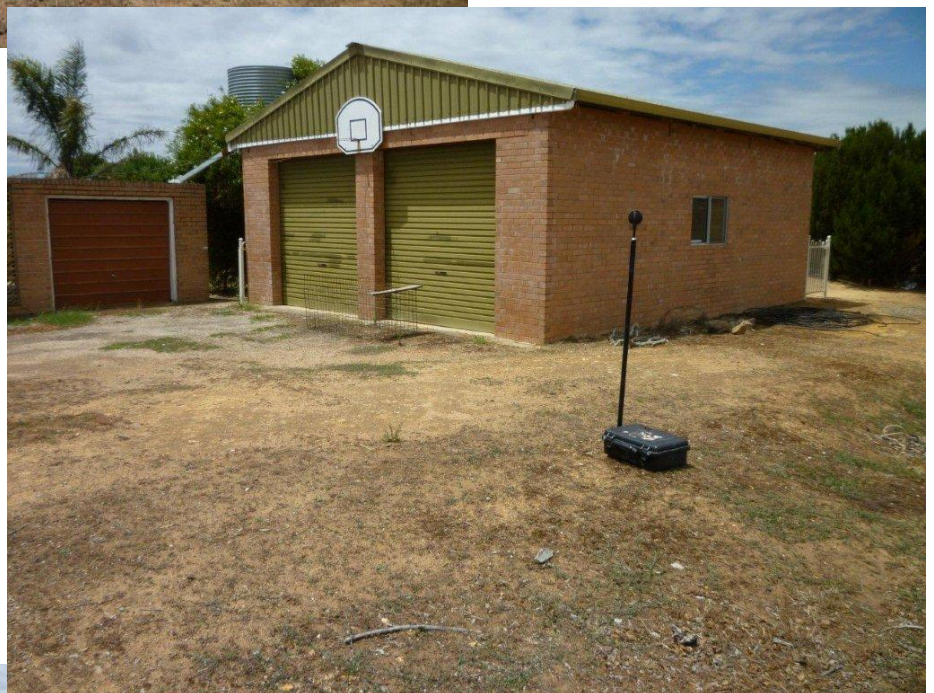
## Location 9



## Location 10



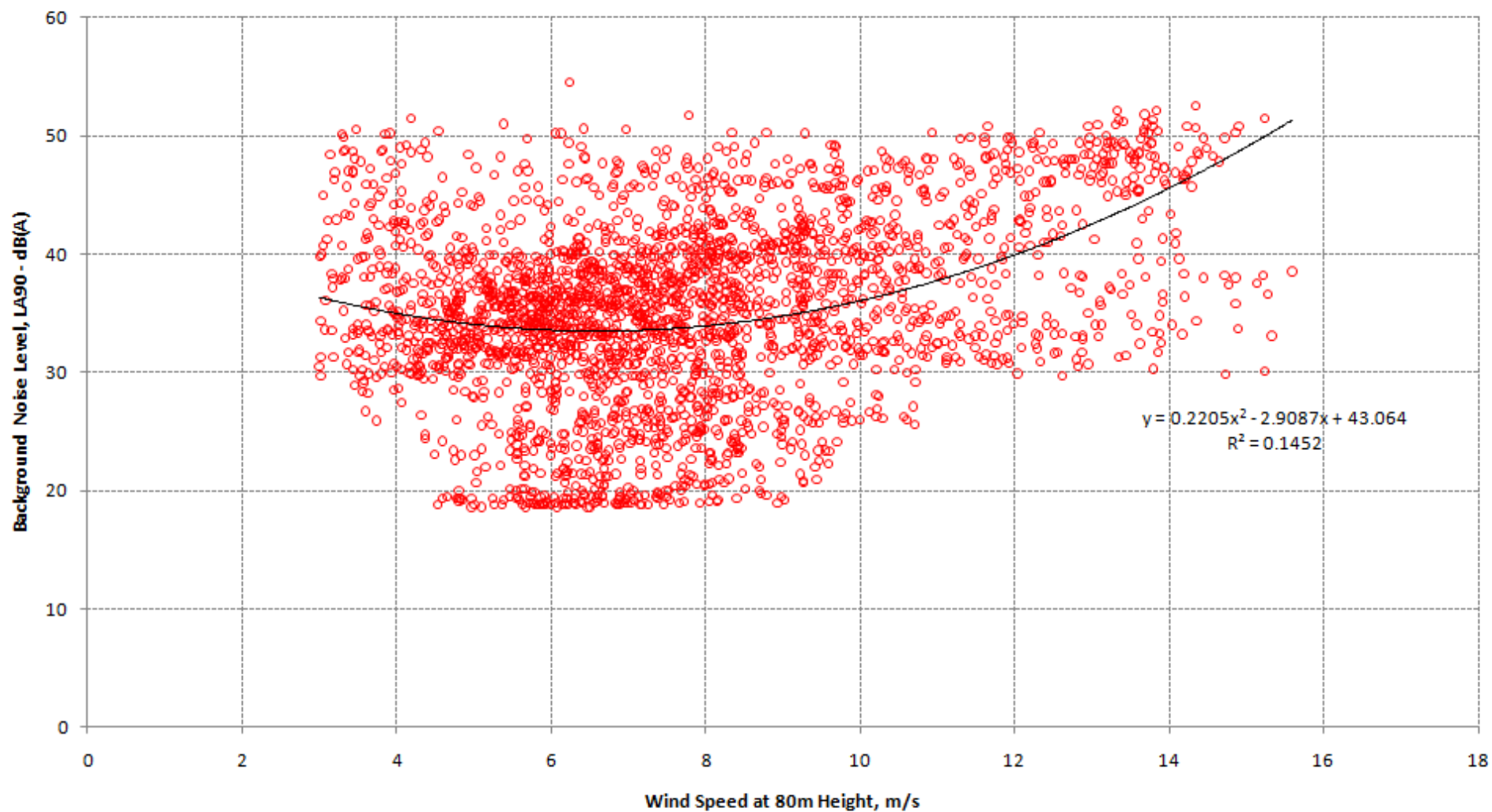
## Location 11



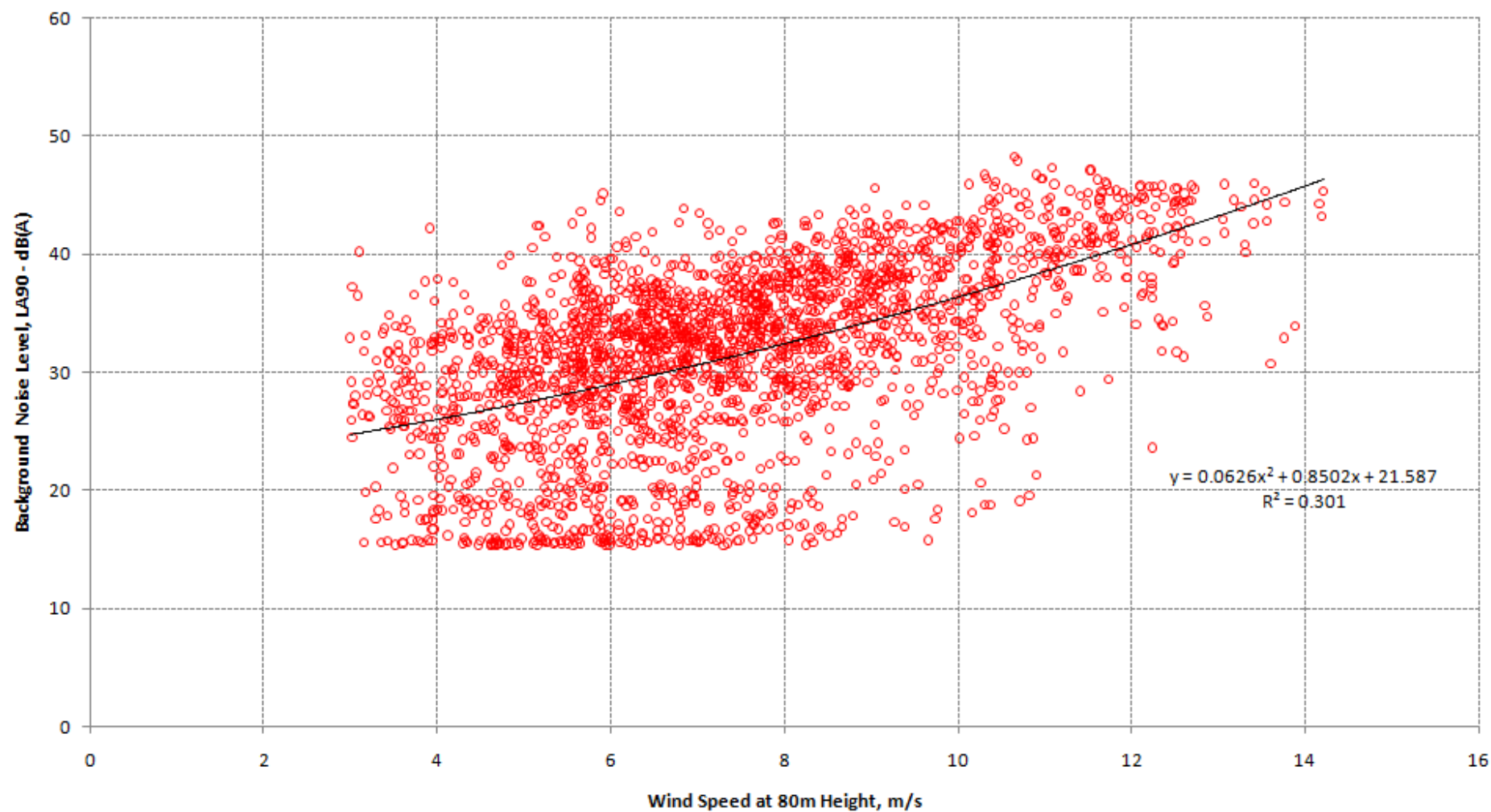
## **APPENDIX C**

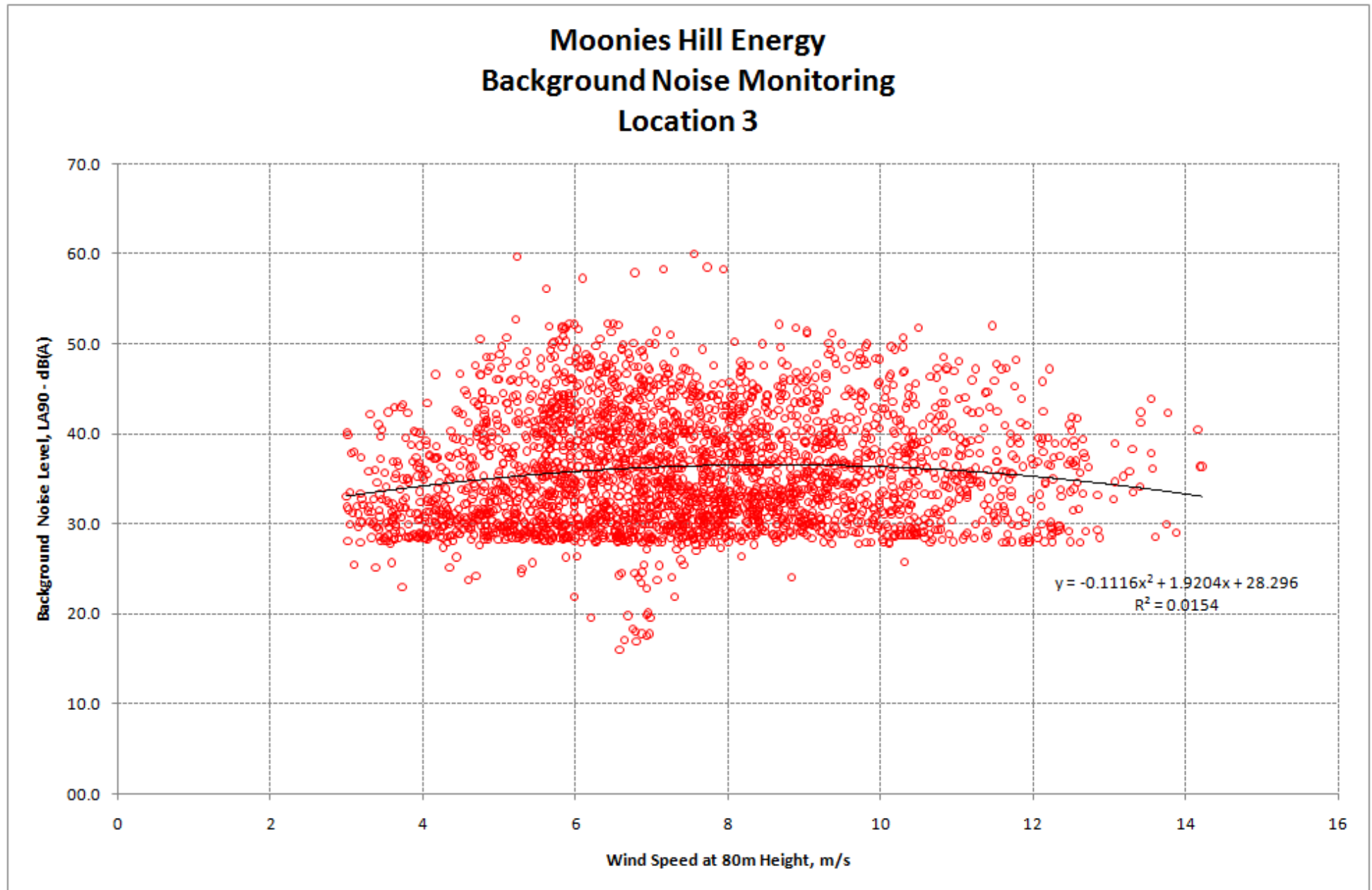
BACKGROUND NOISE LEVELS vs WIND SPEED PLOTS

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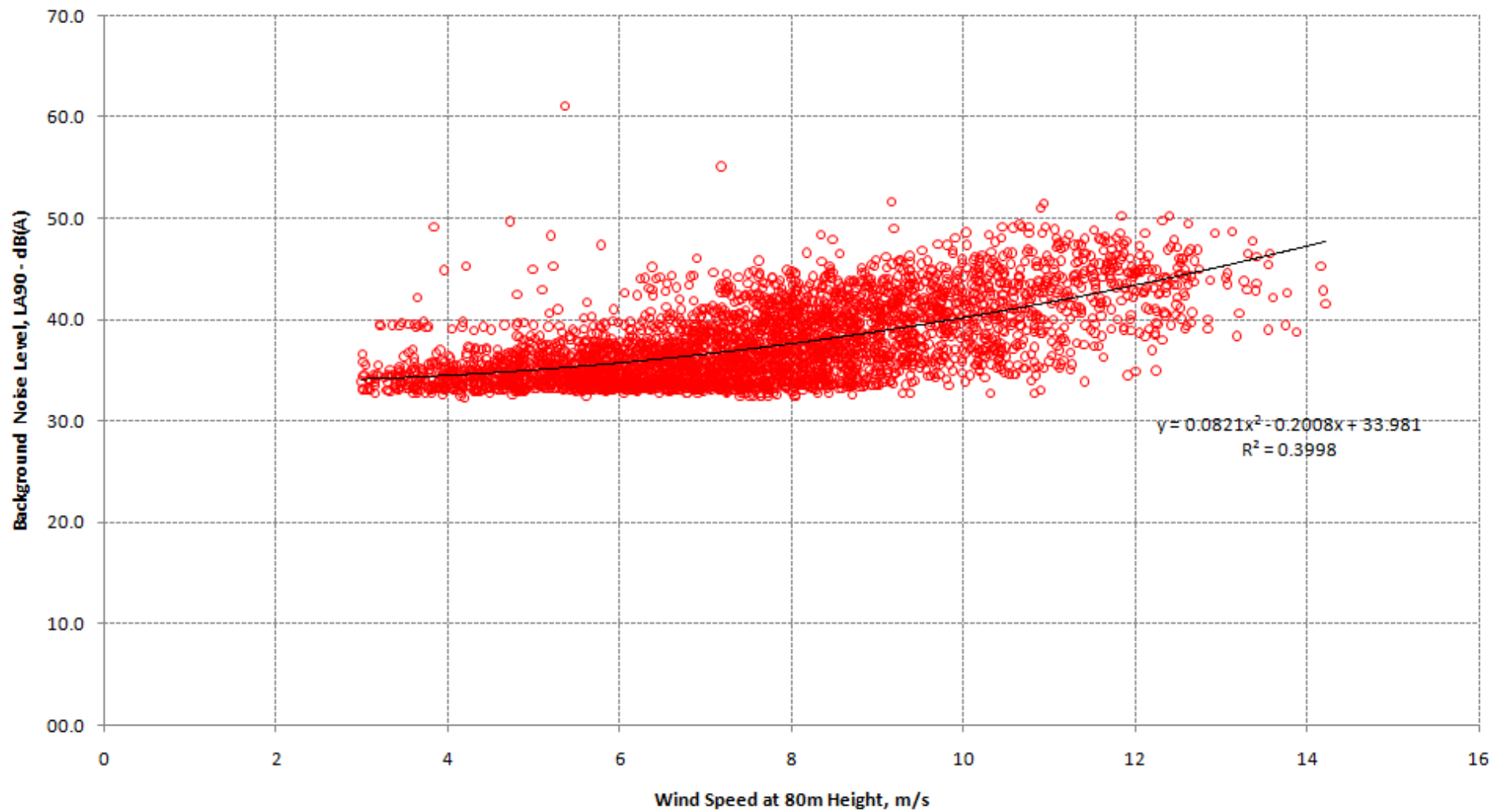


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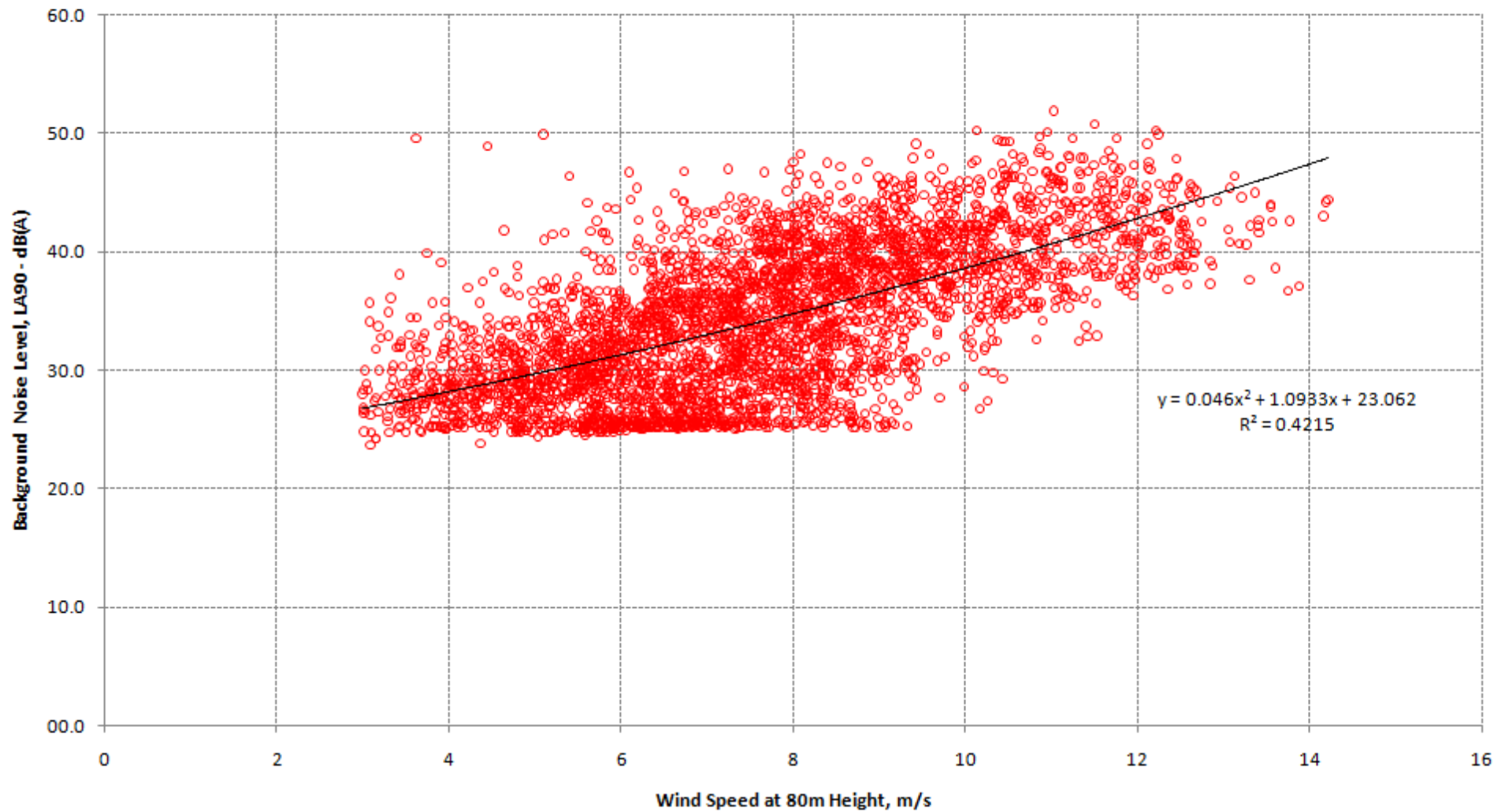




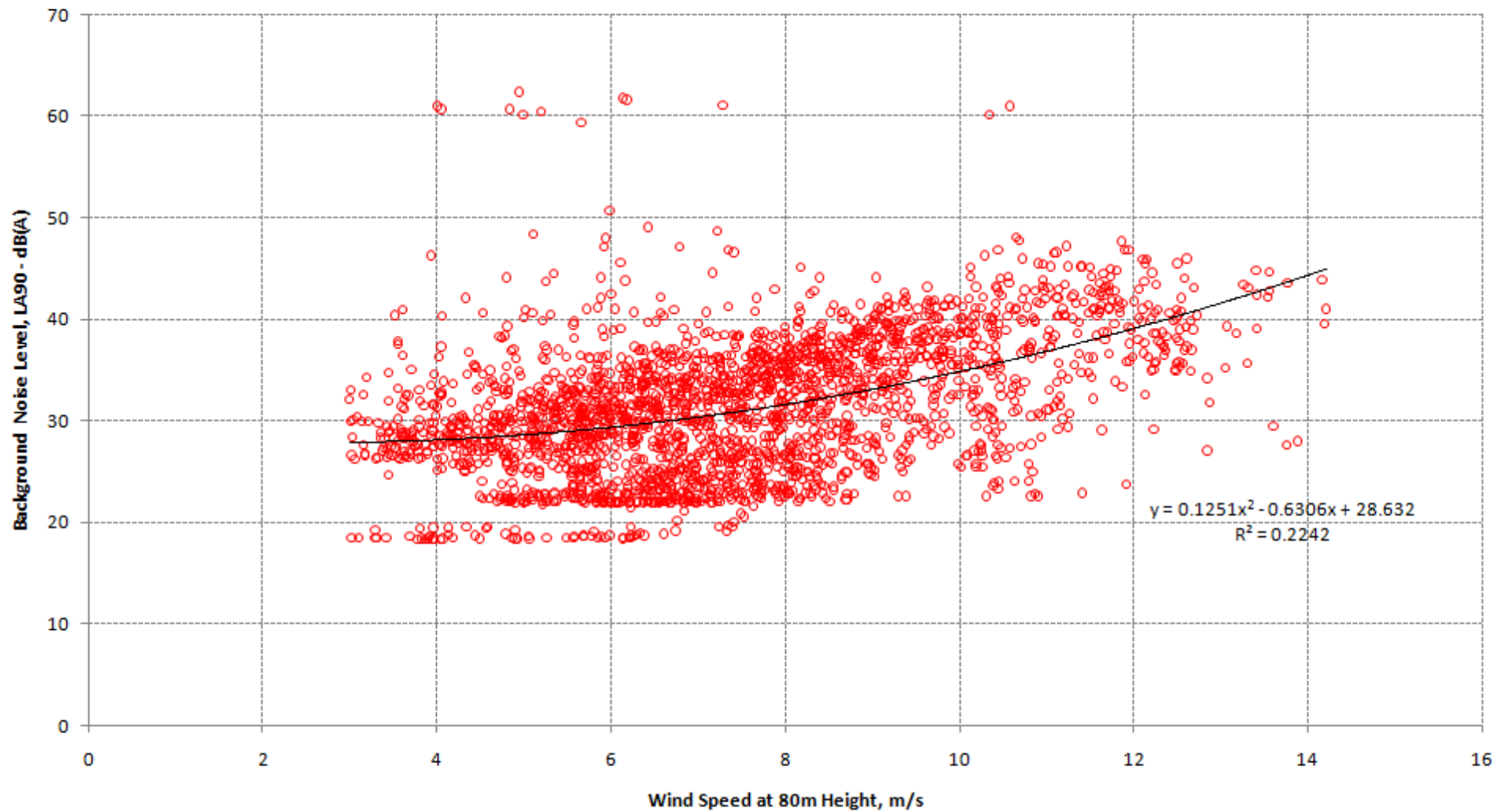
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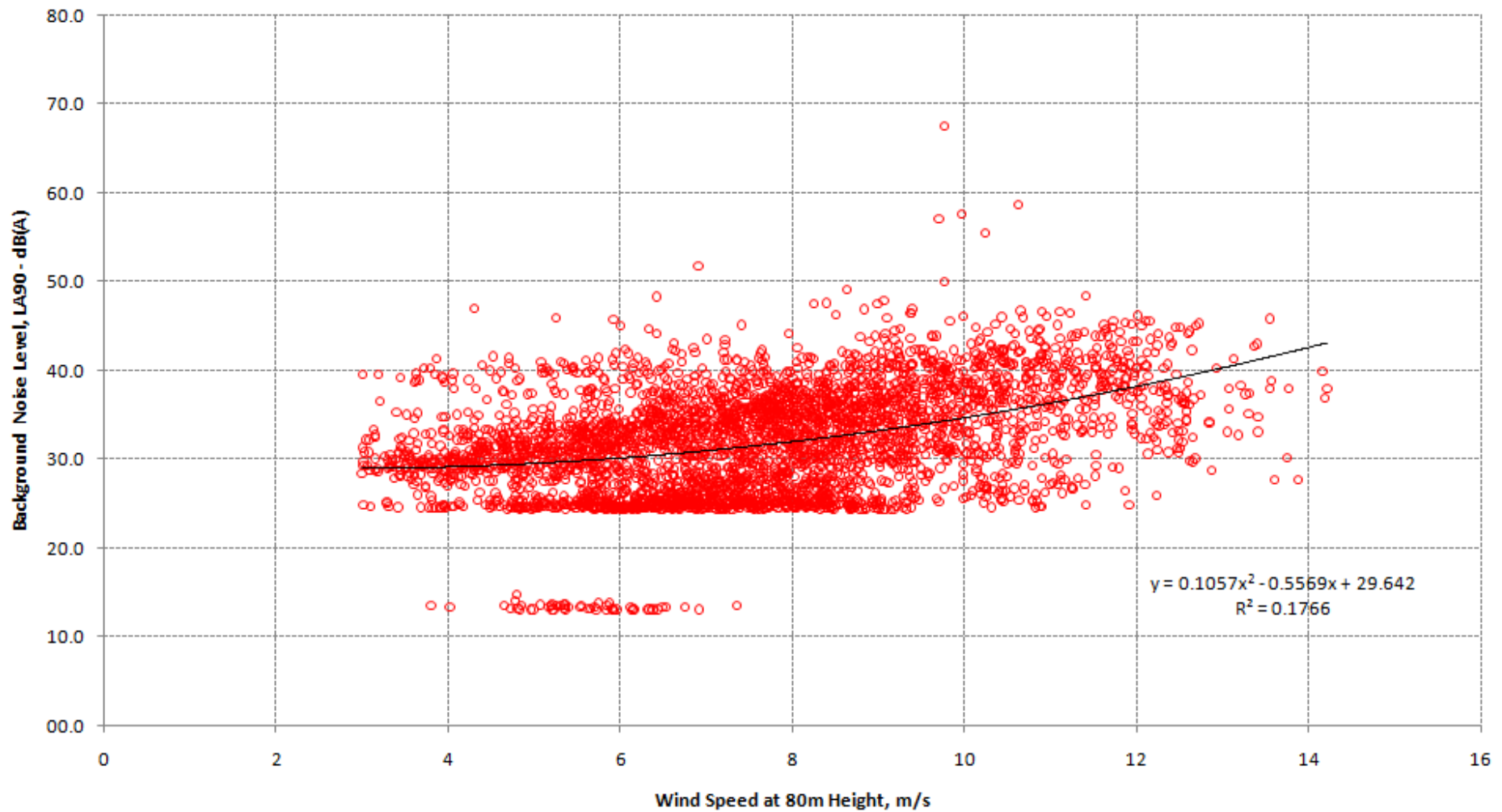
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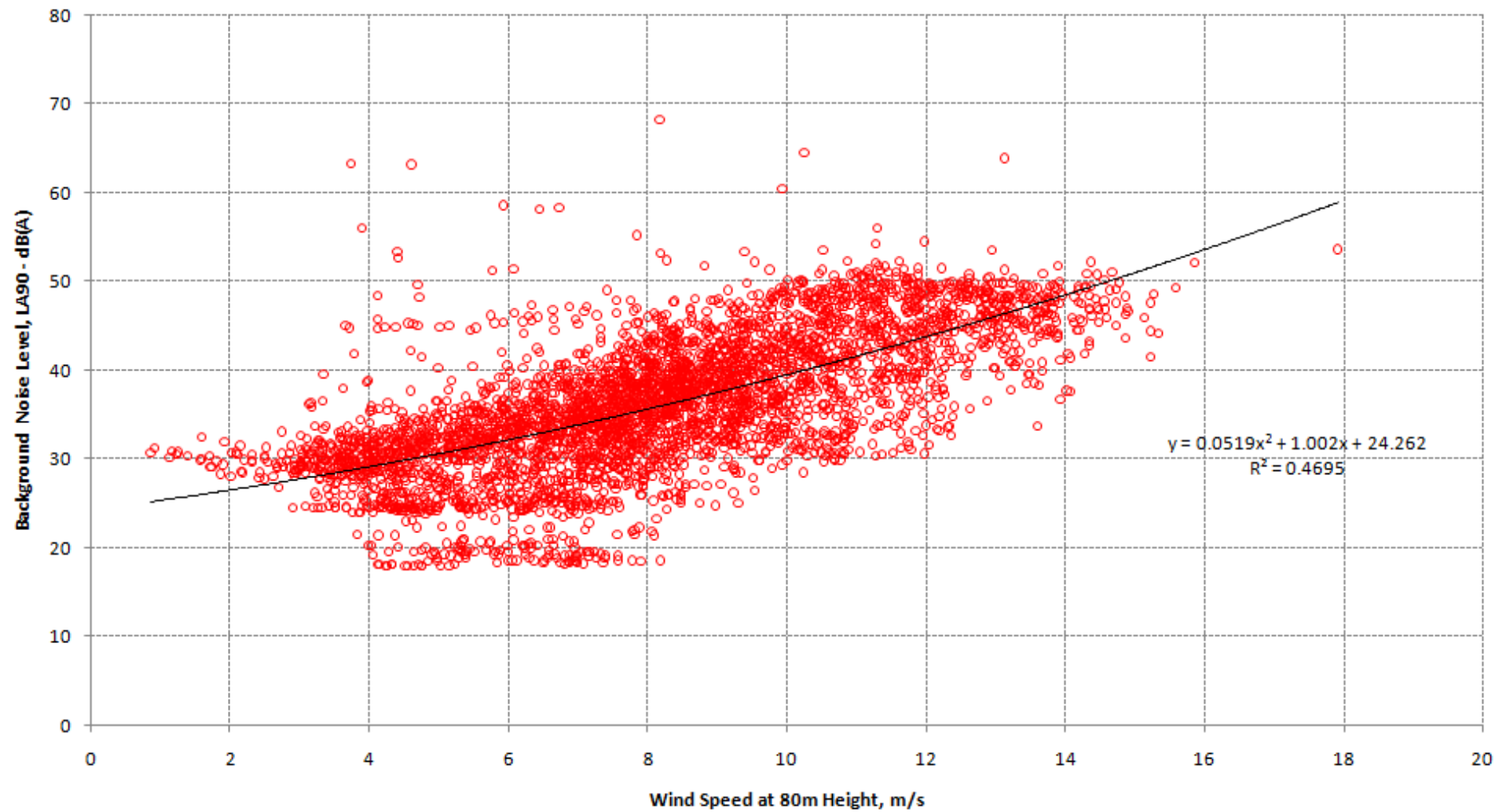
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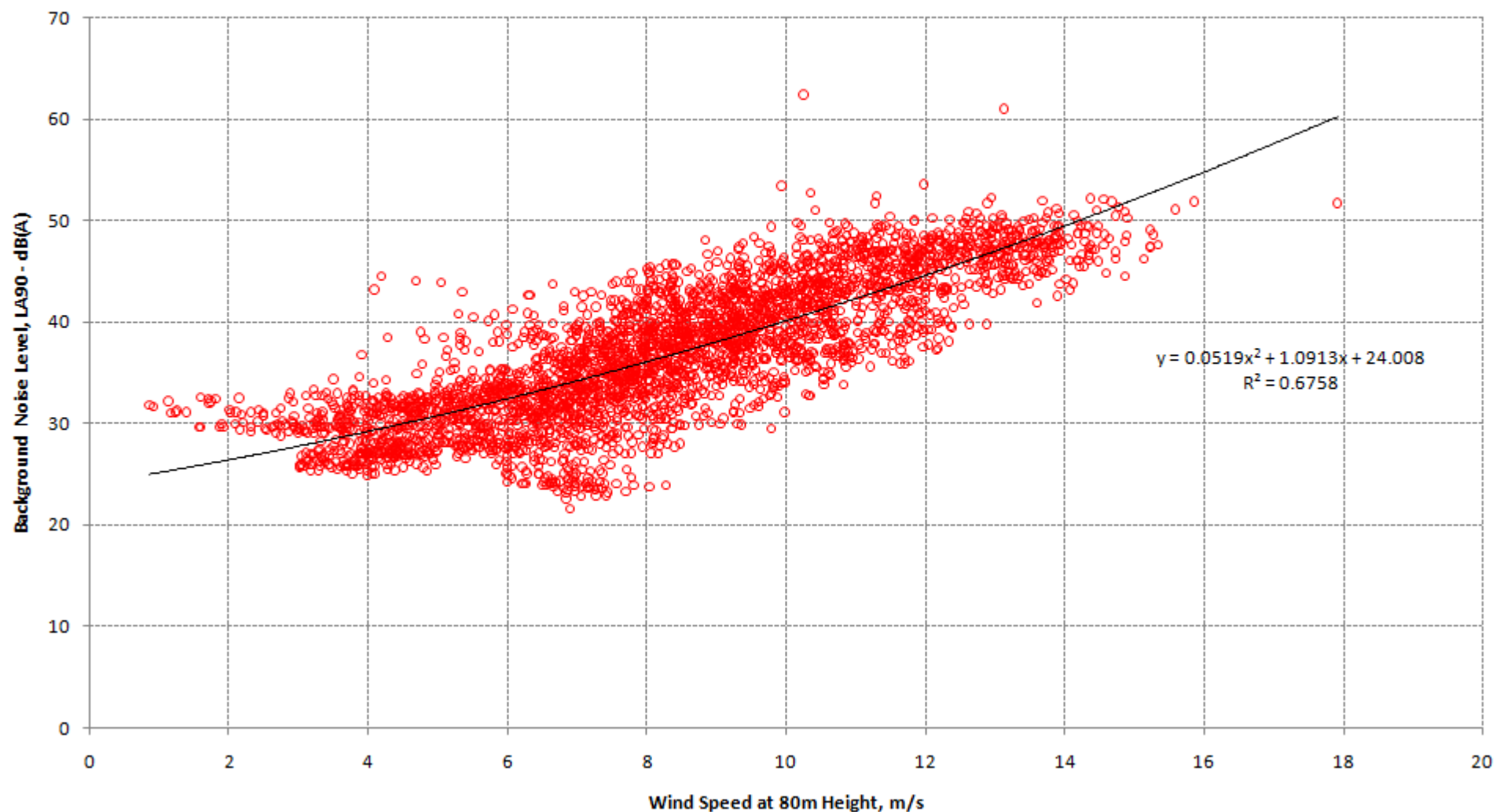
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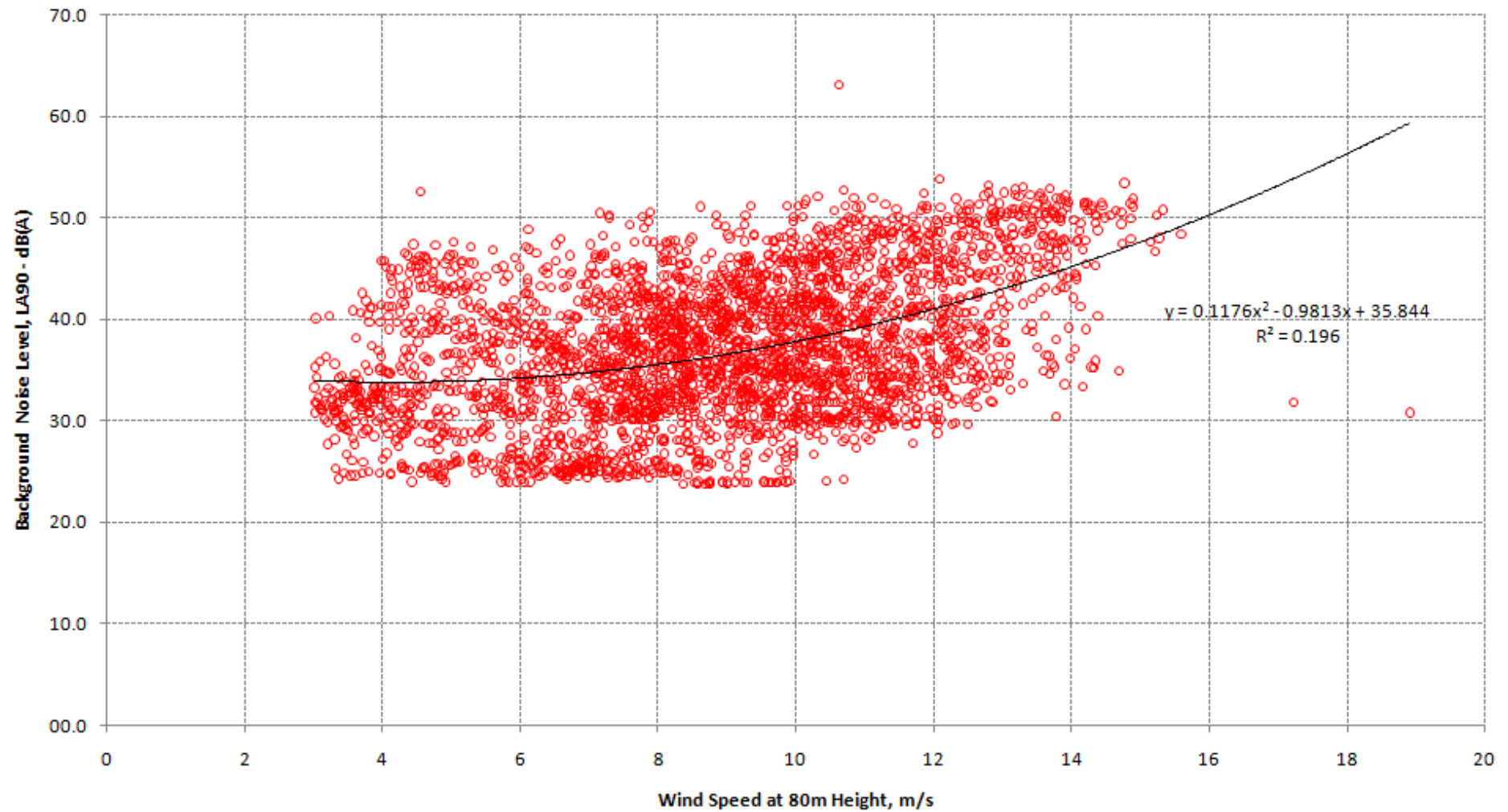
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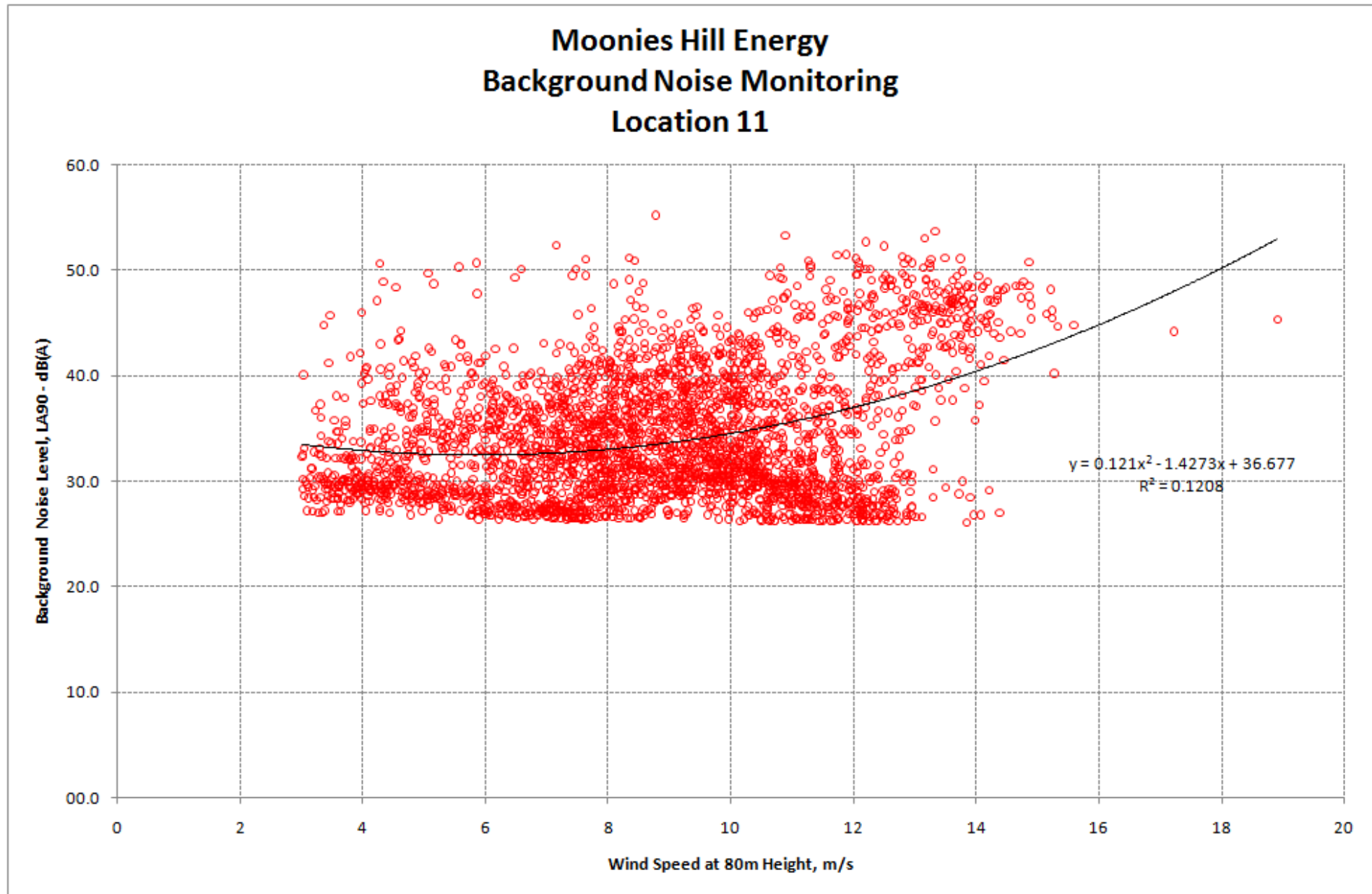


## Moonies Hill Energy Background Noise Monitoring Location 9



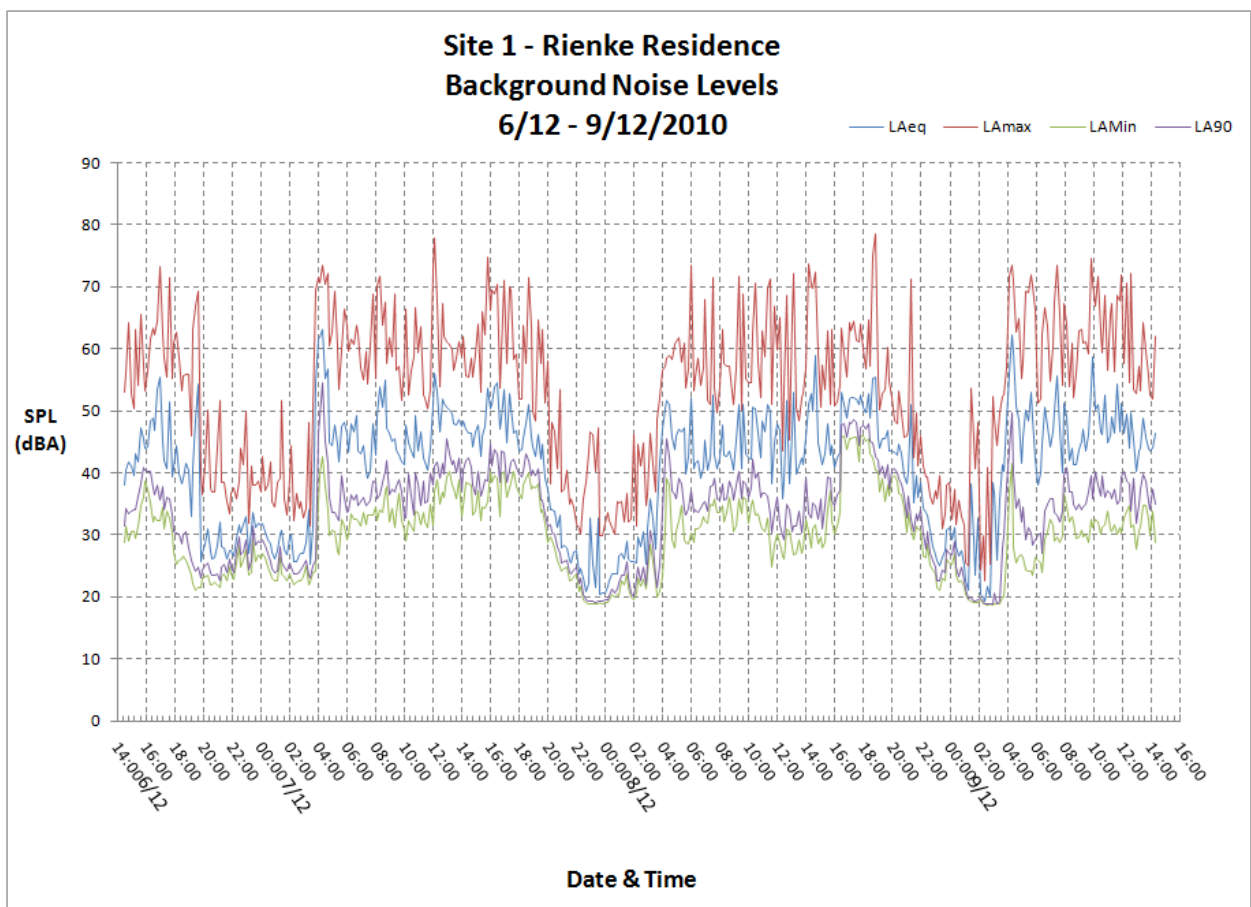
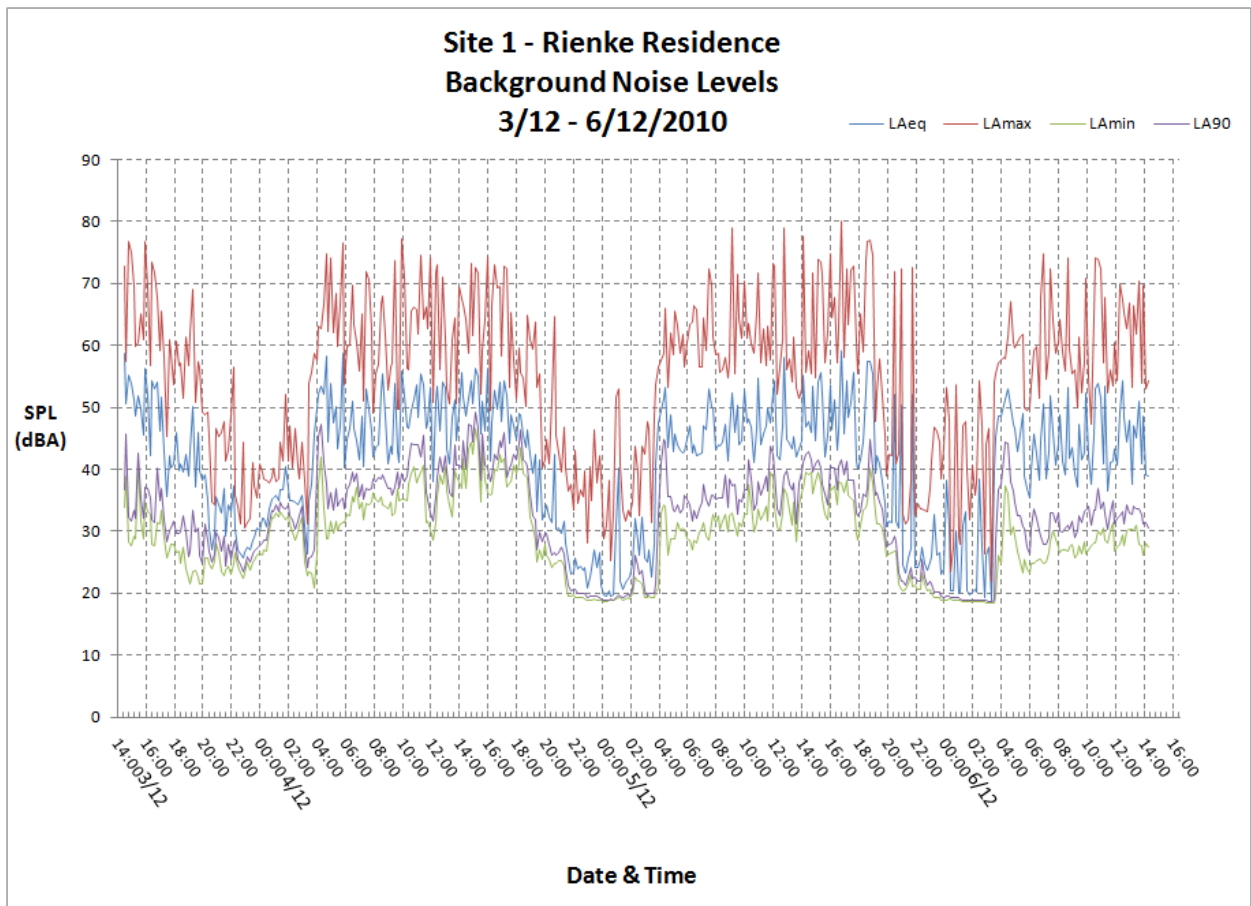
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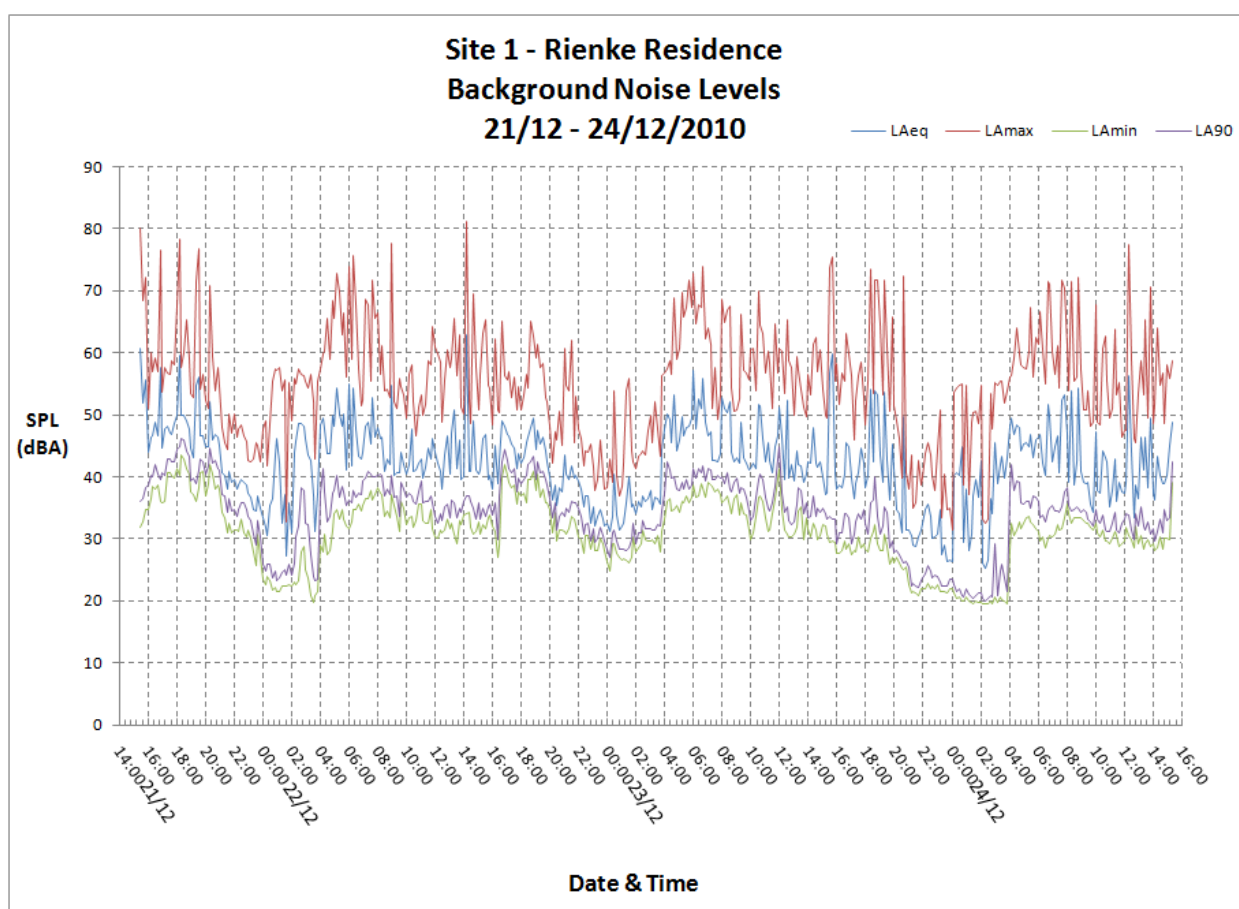
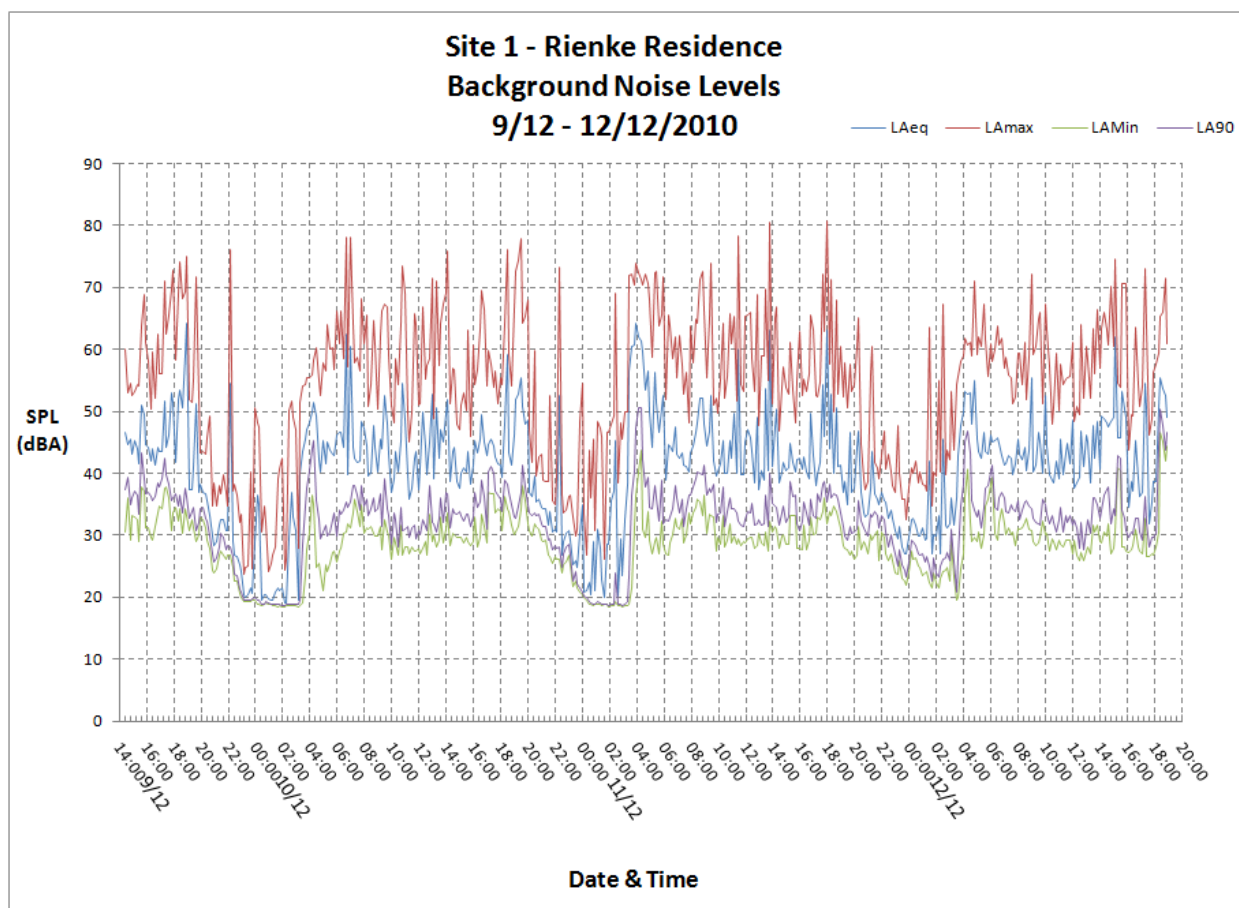


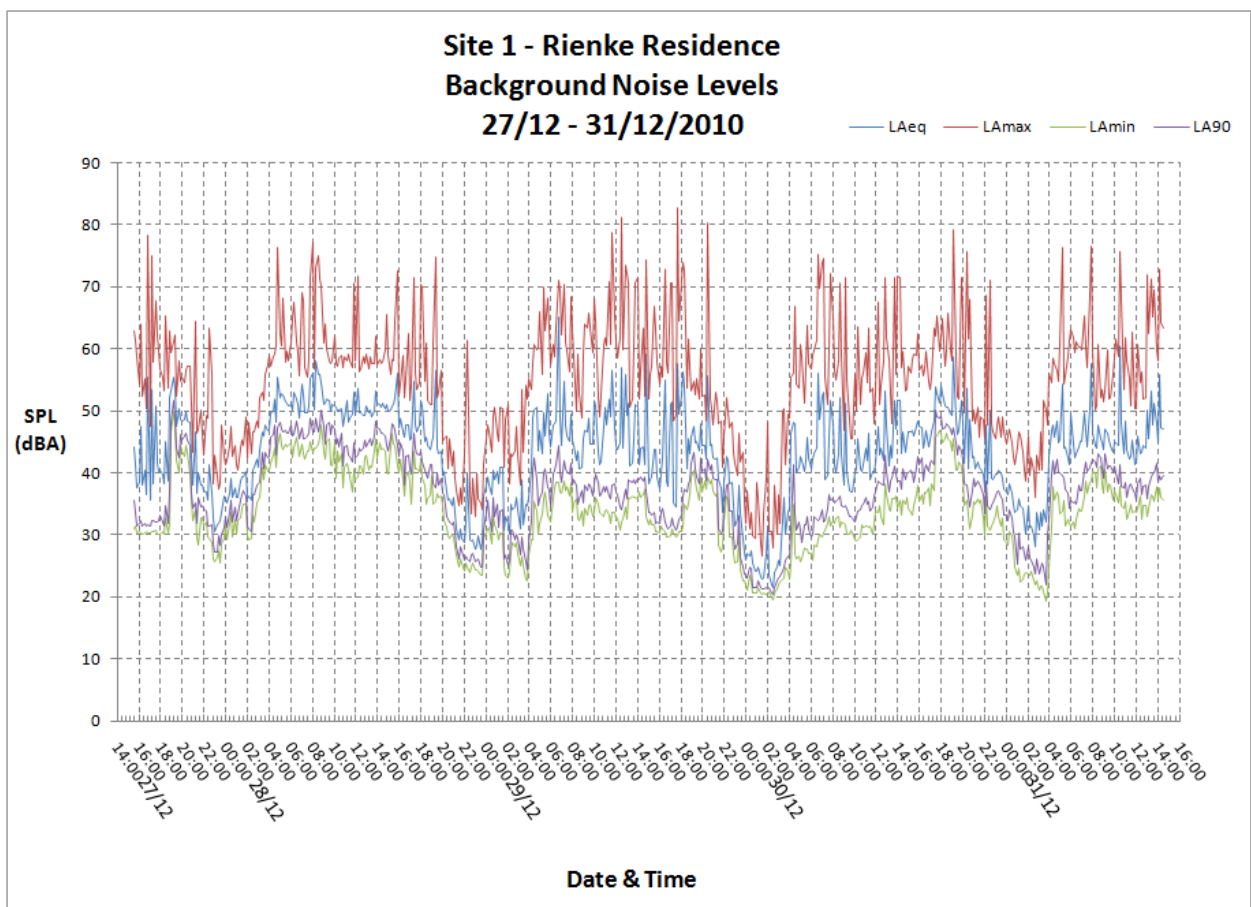
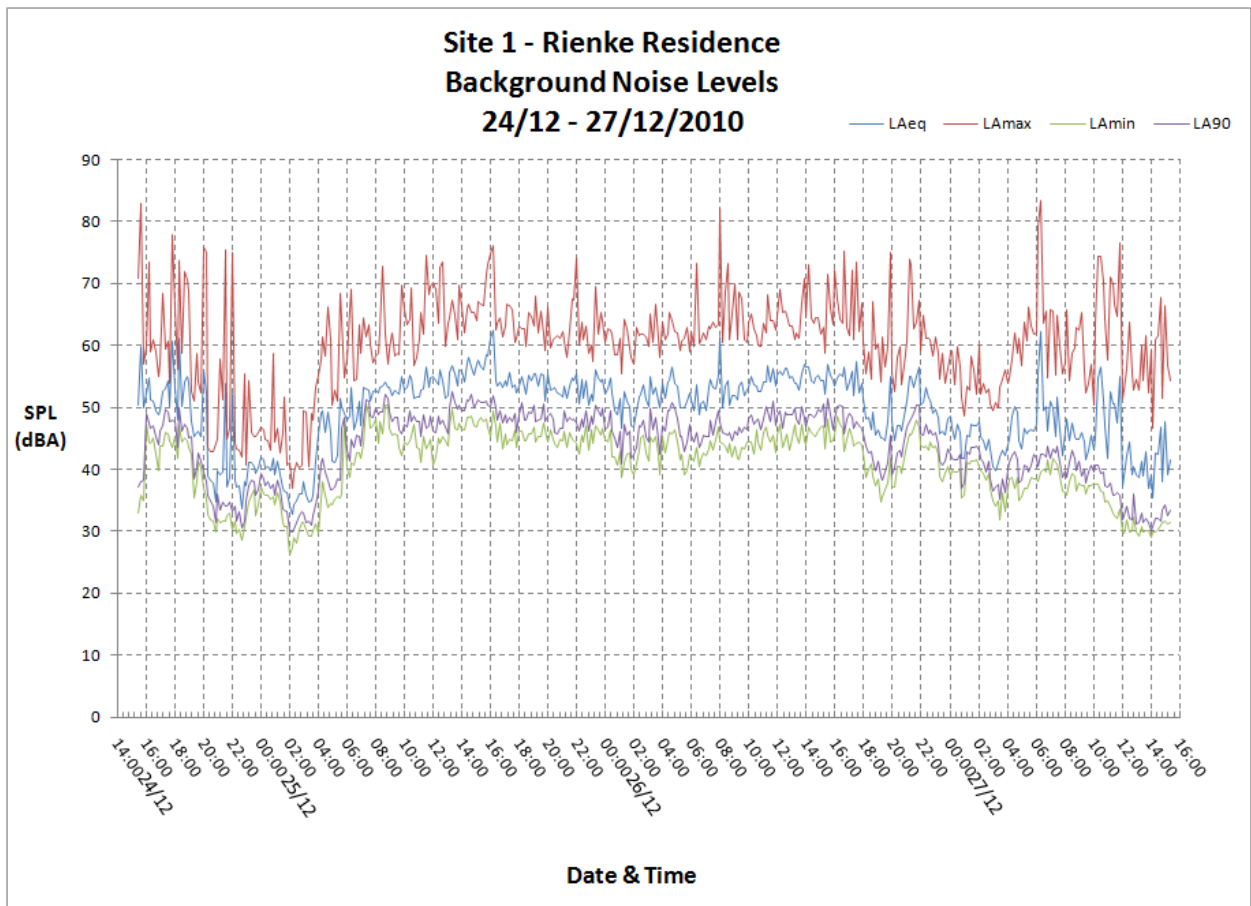


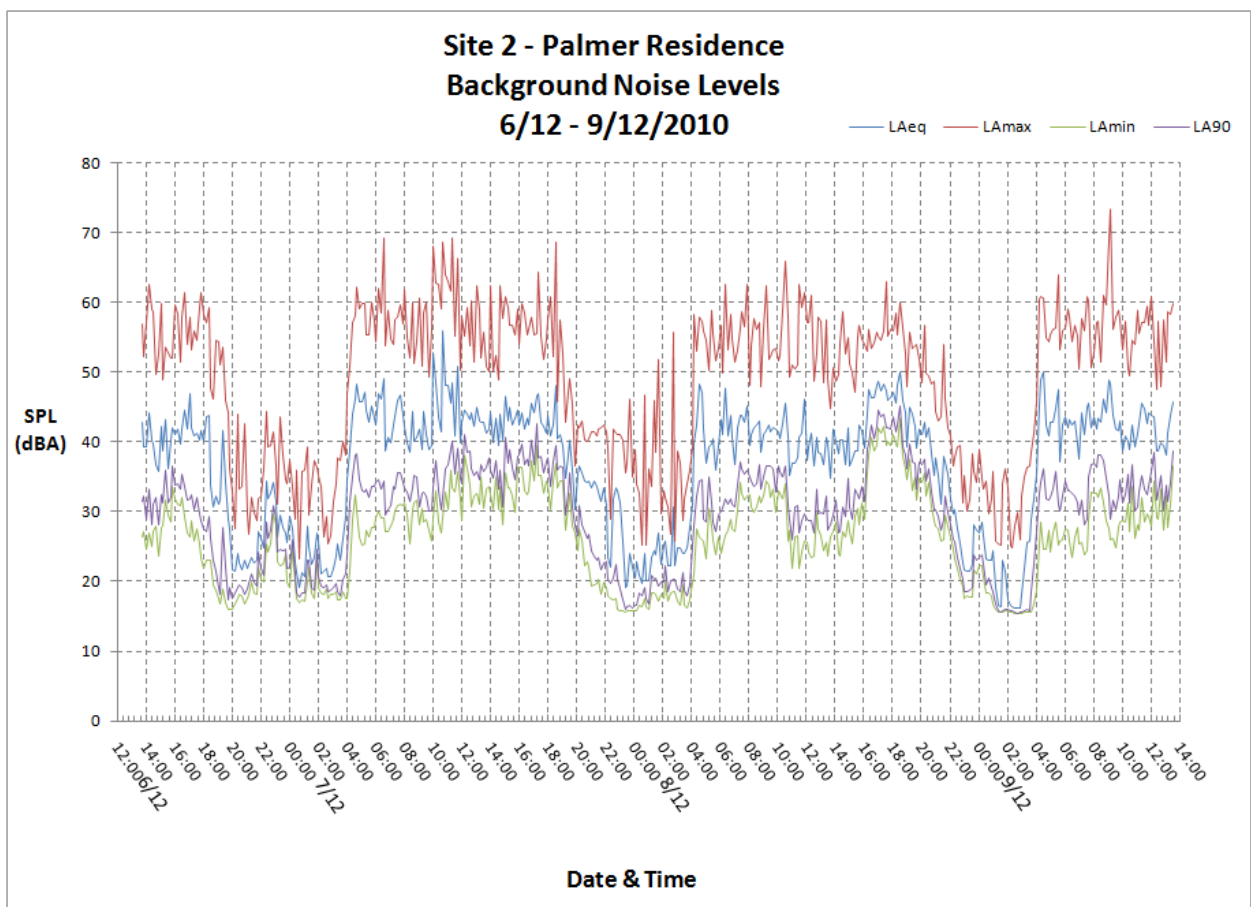
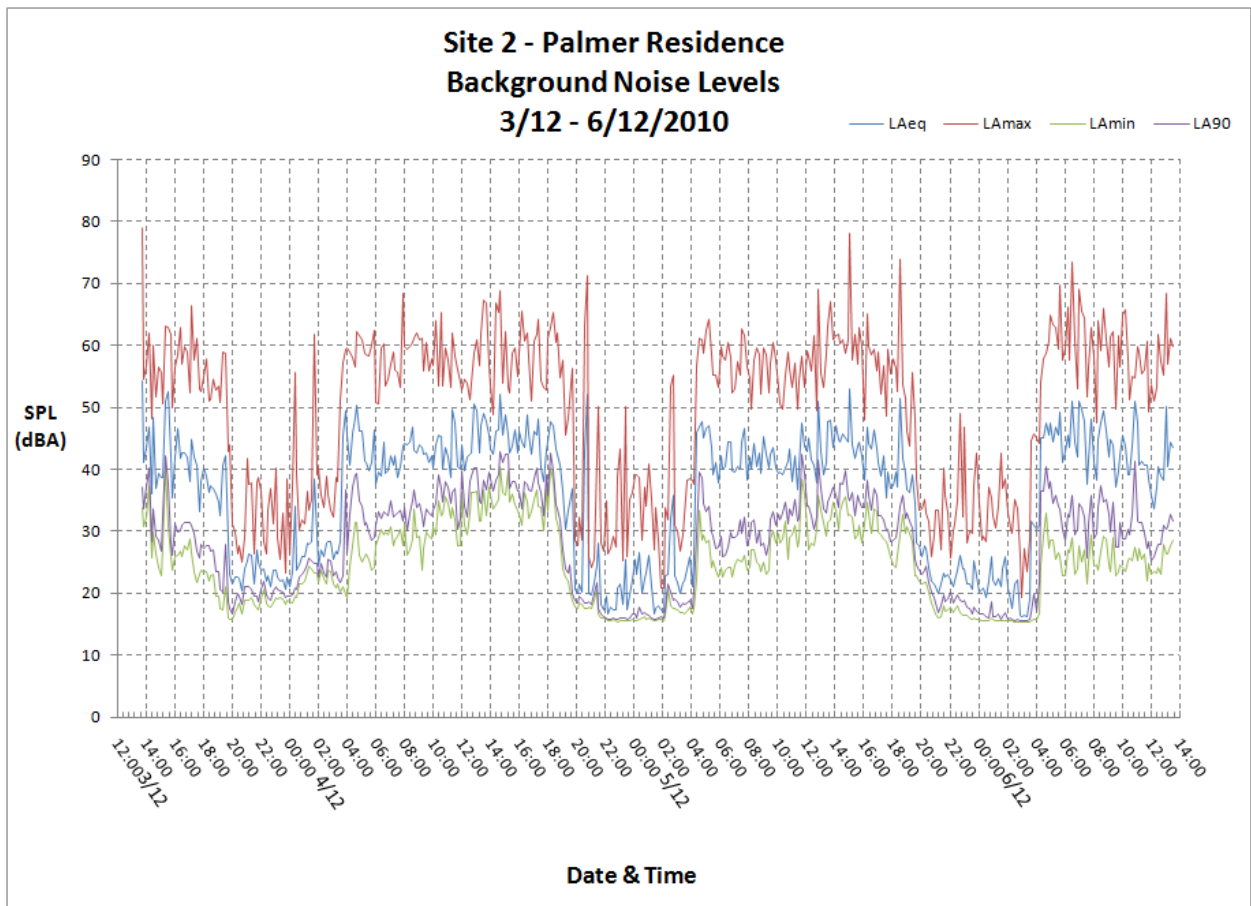
## **APPENDIX D**

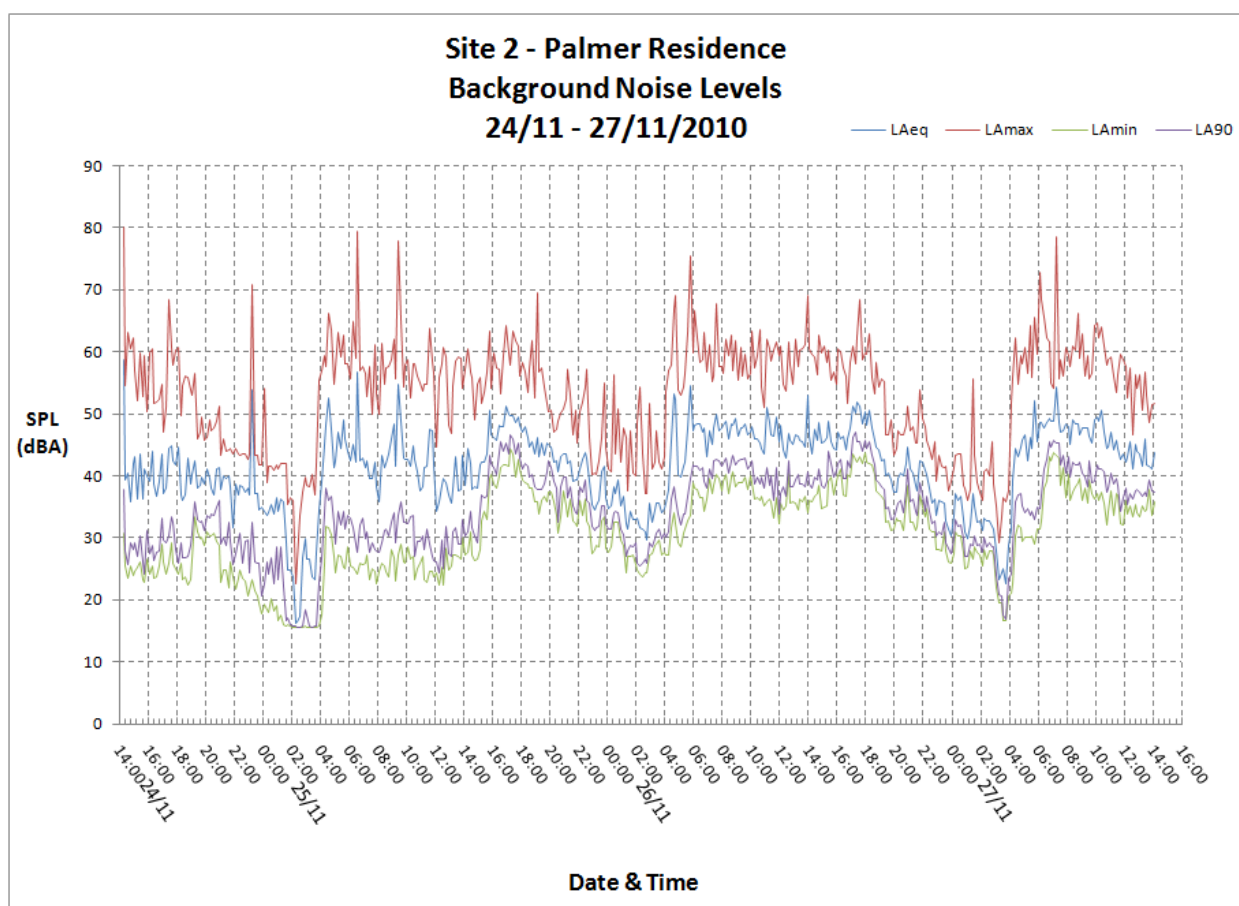
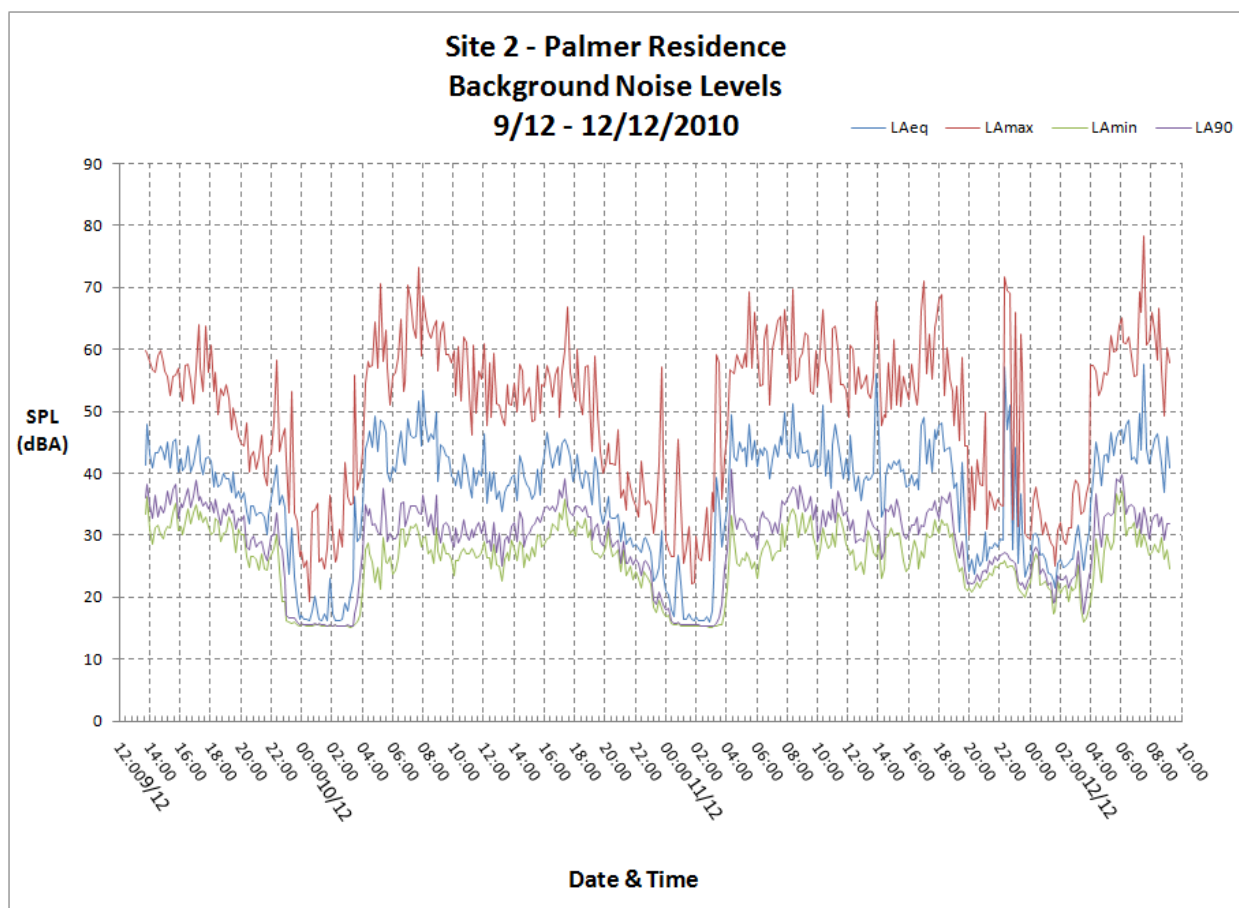
### **BACKGROUND NOISE LEVELS TIME HISTORY PLOTS**

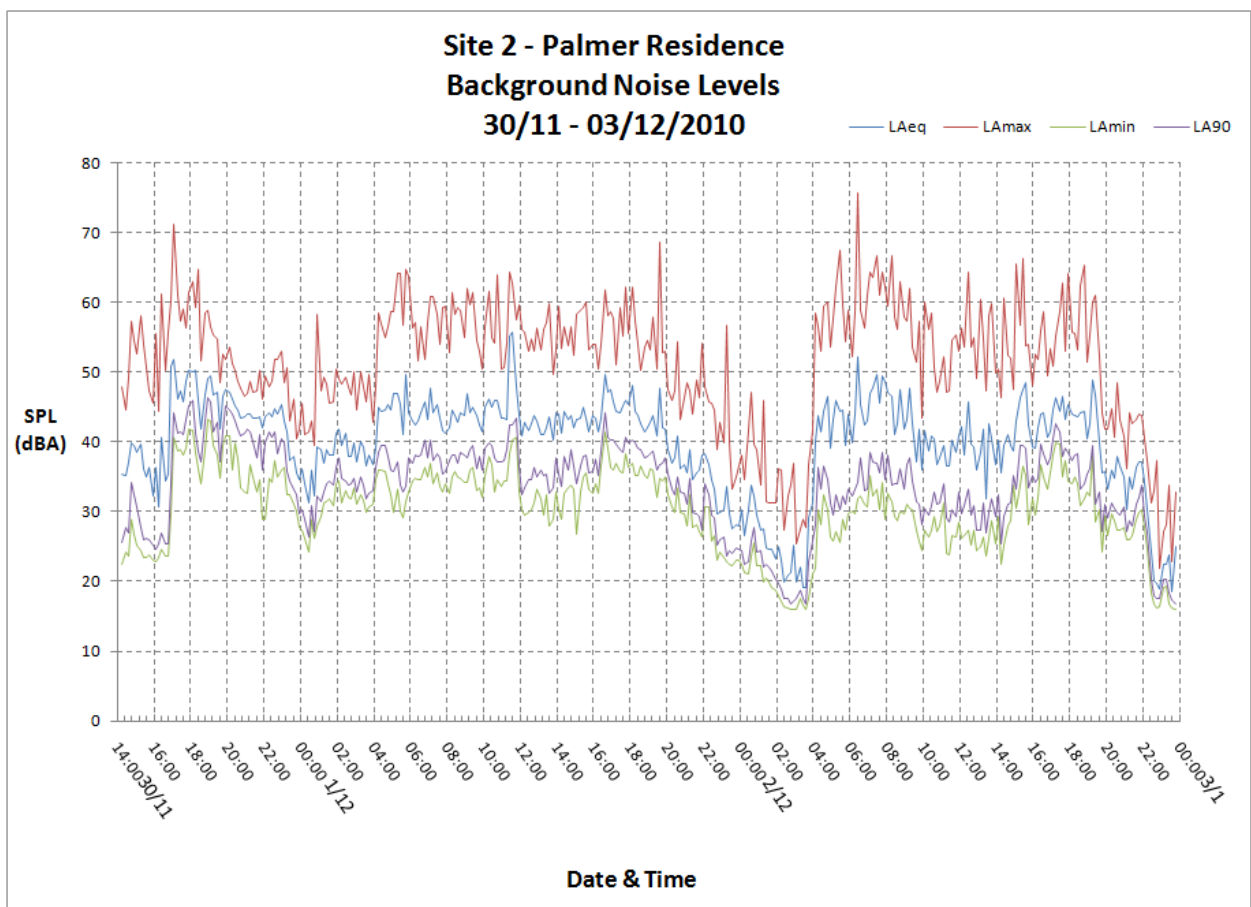
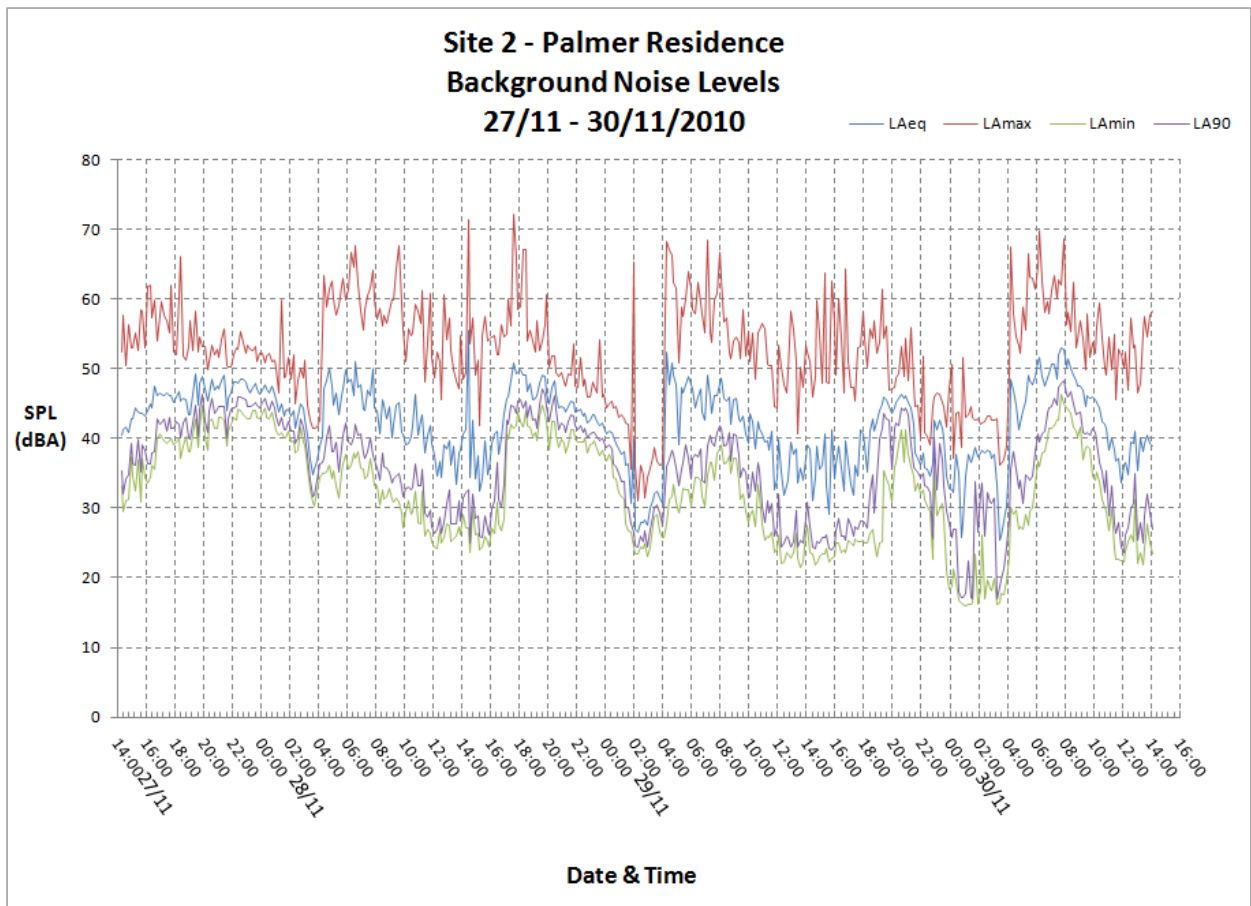


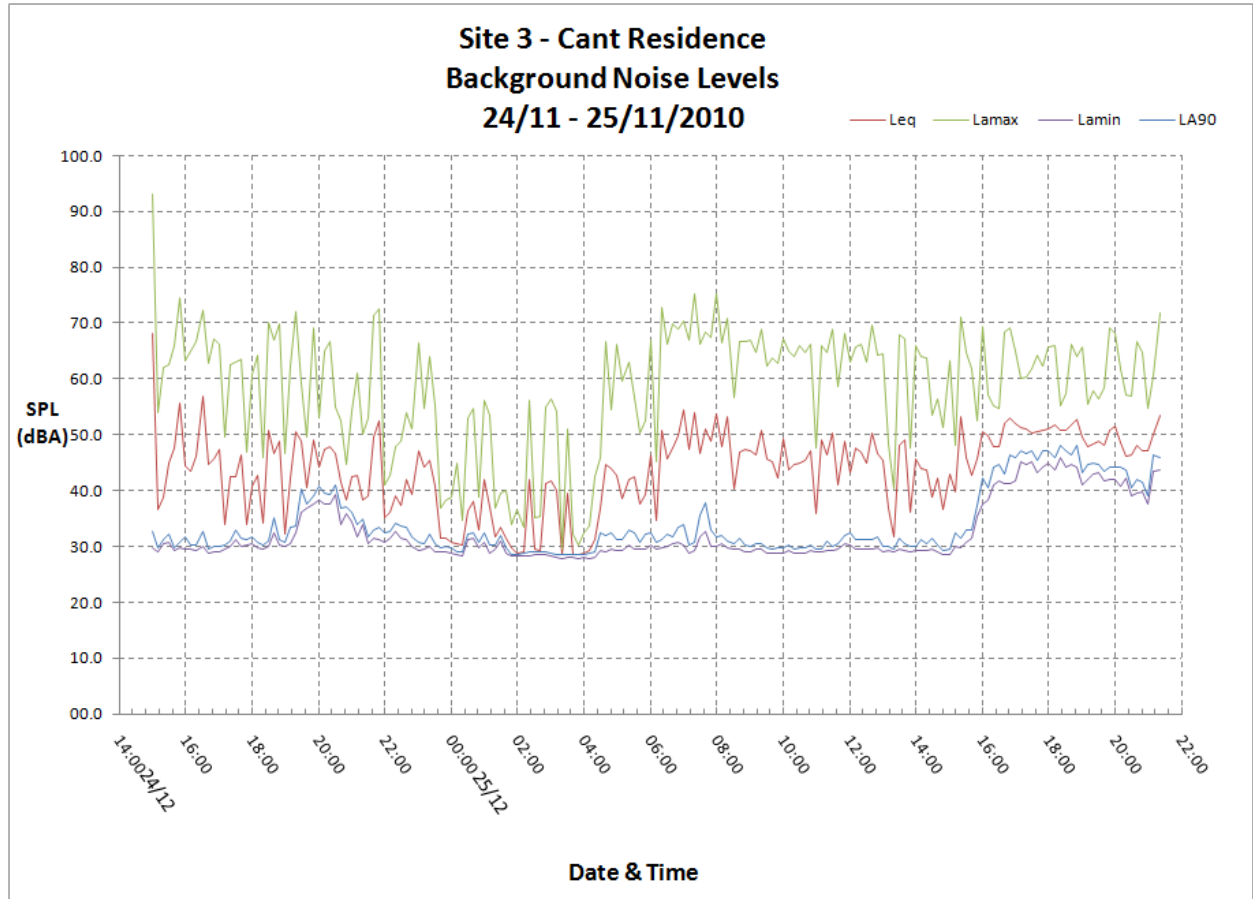
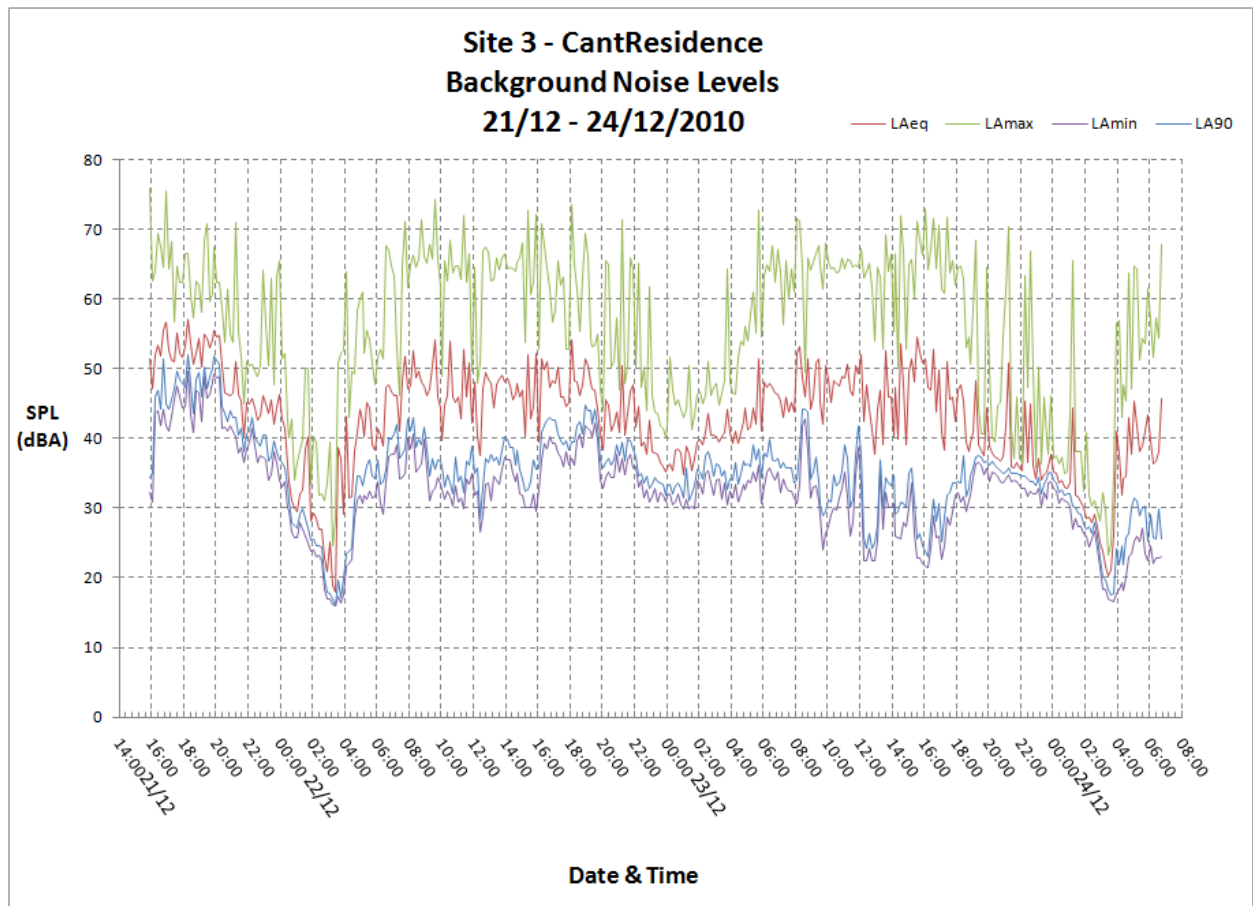


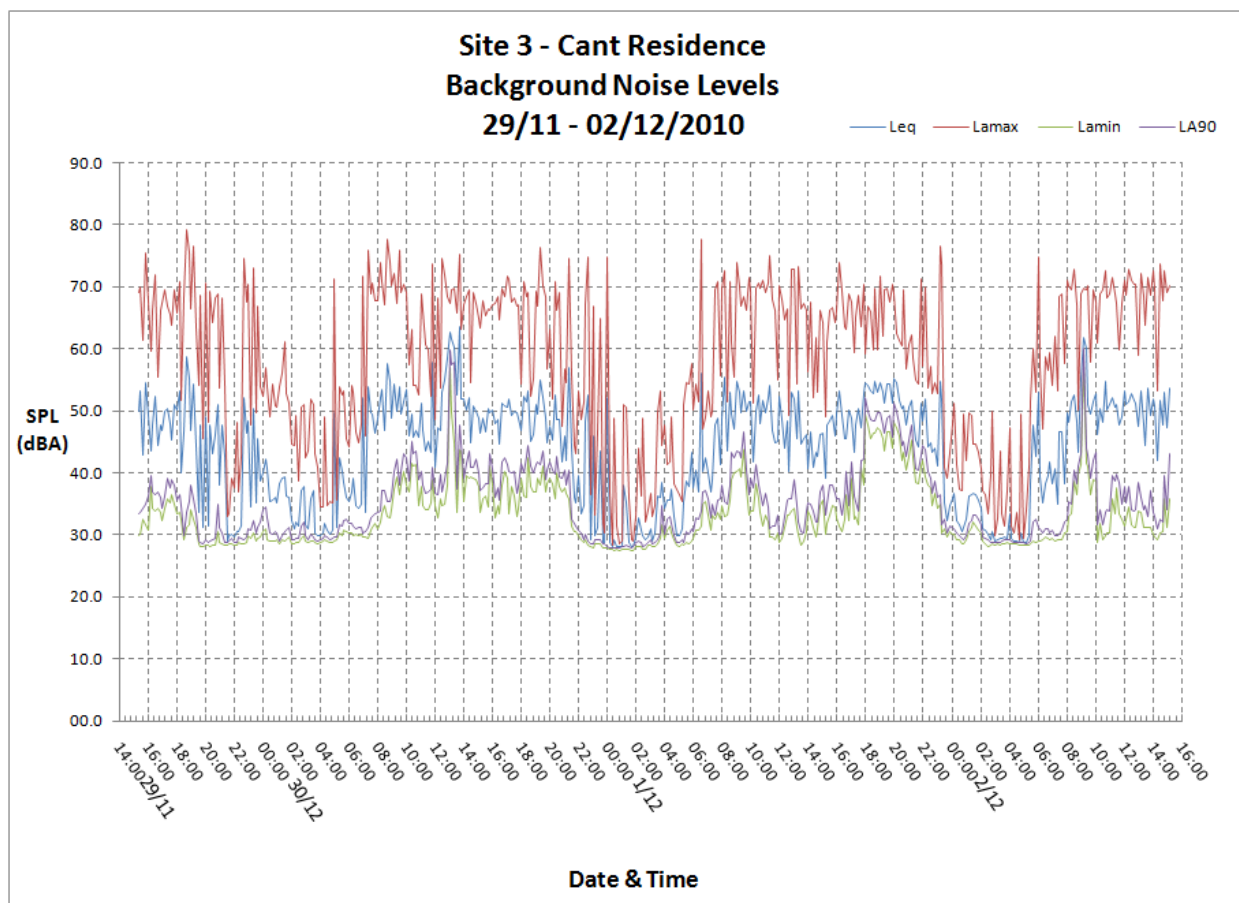
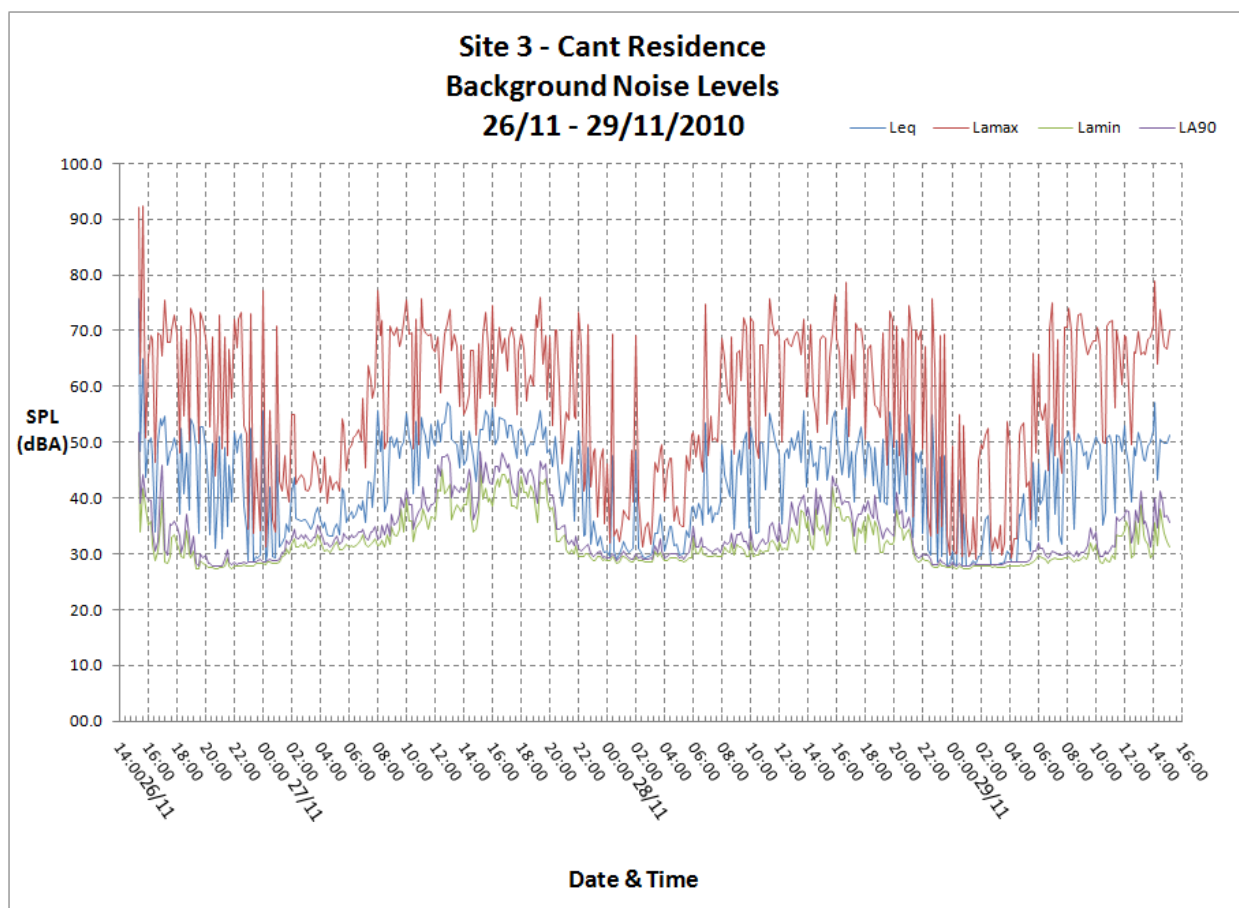


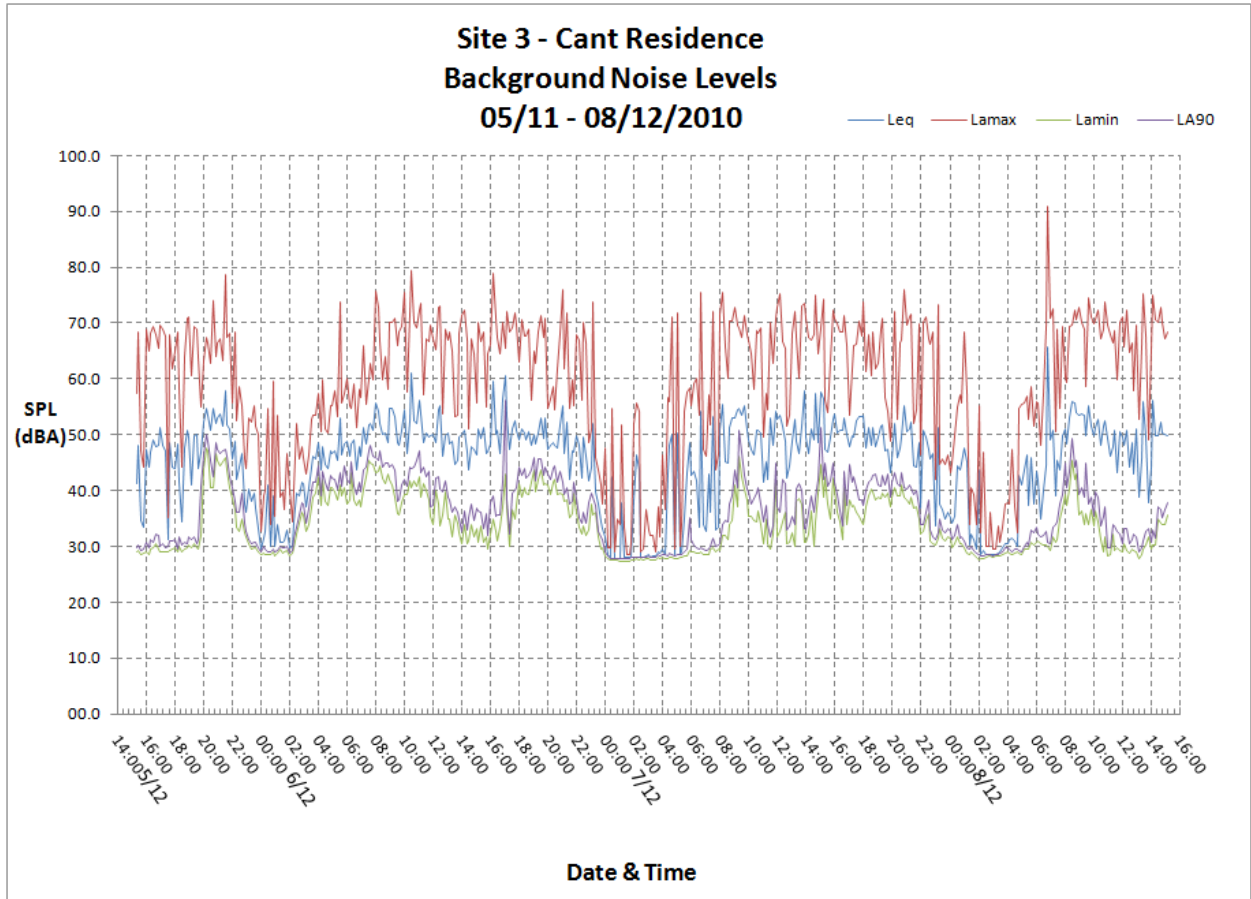
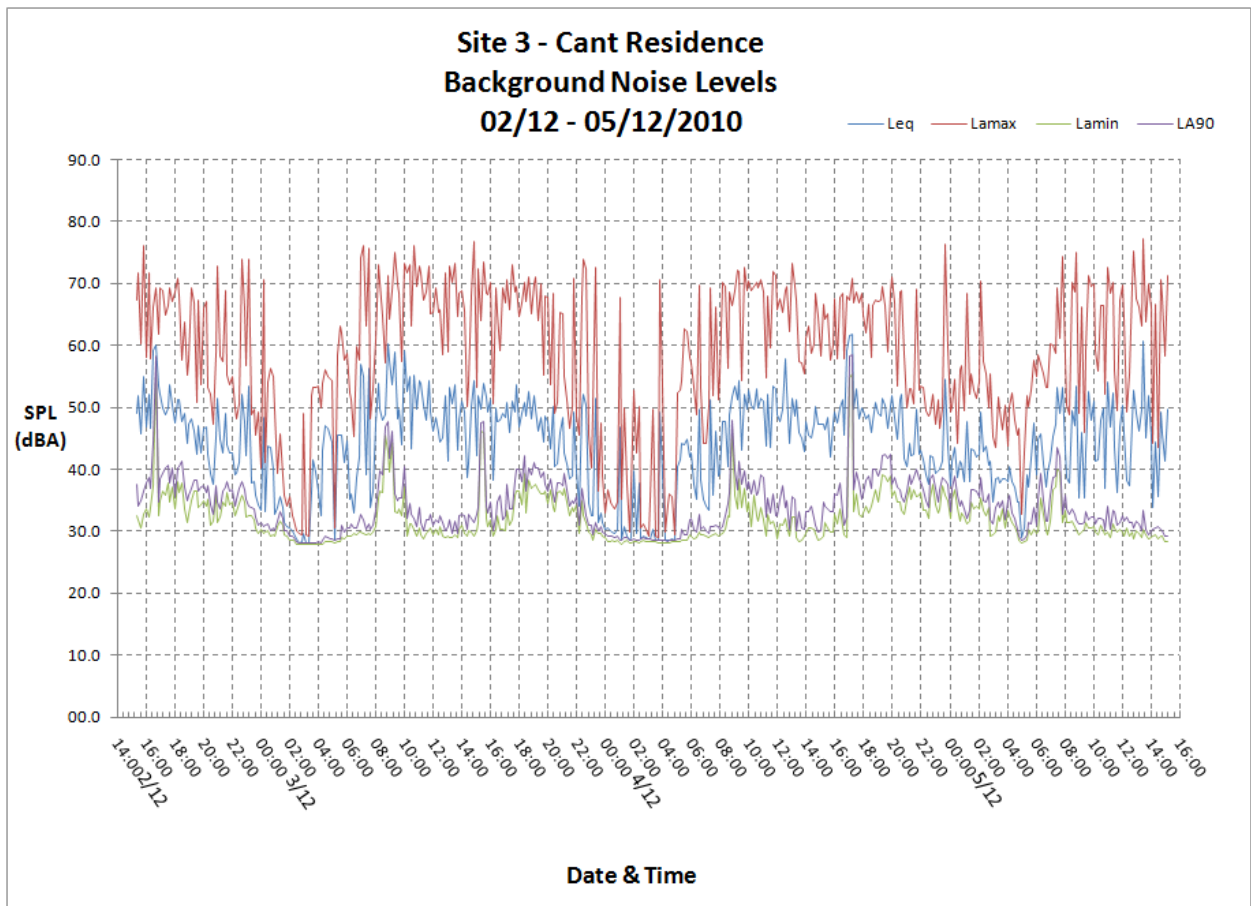


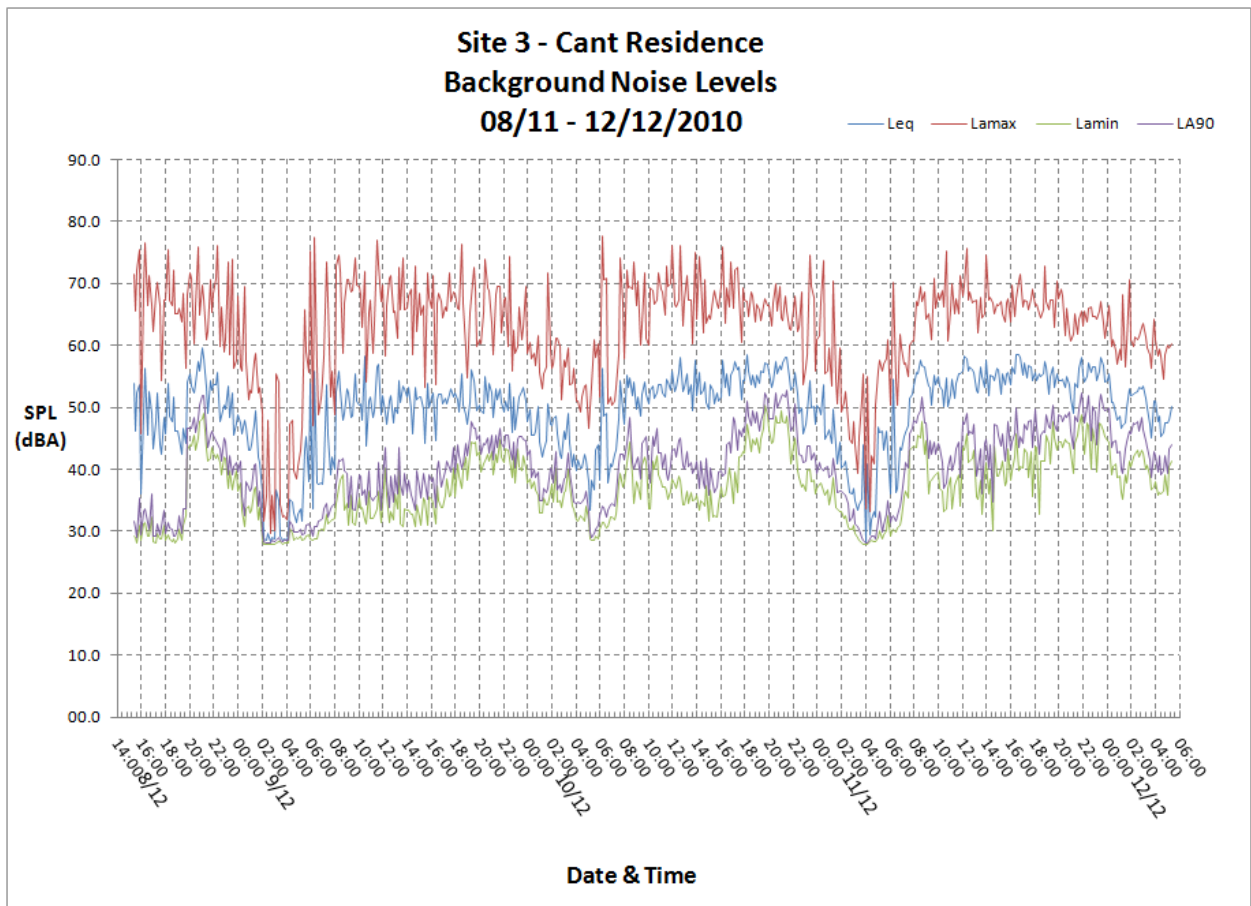


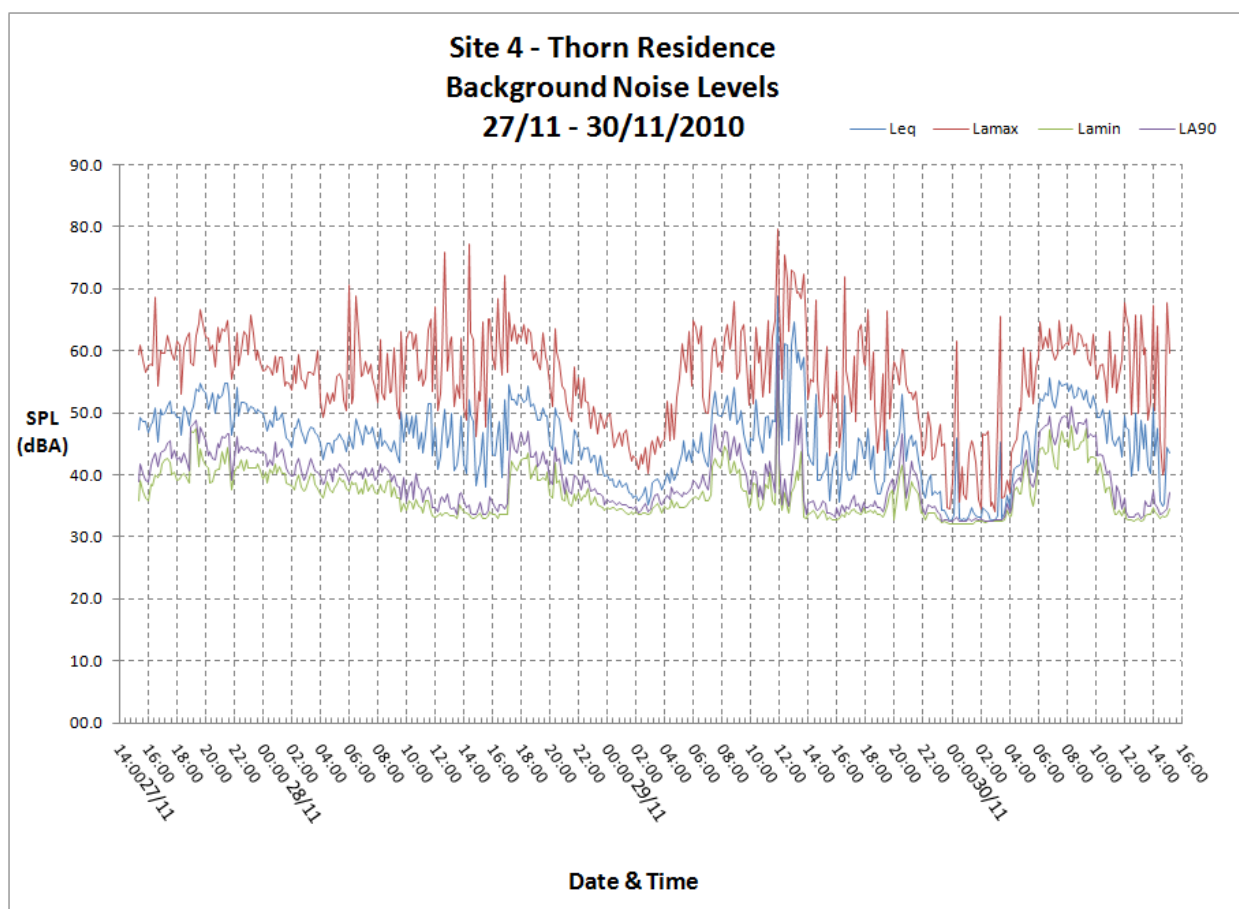


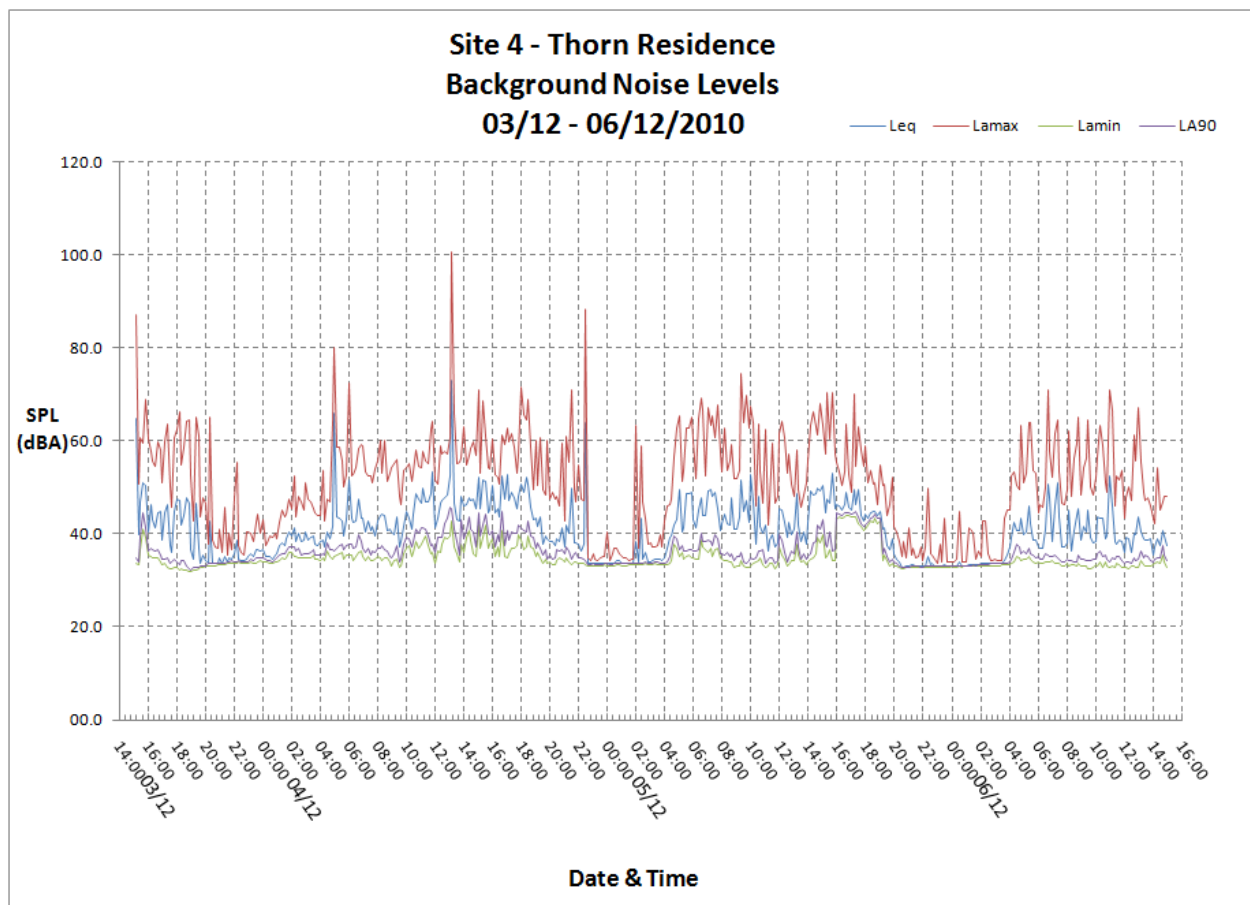


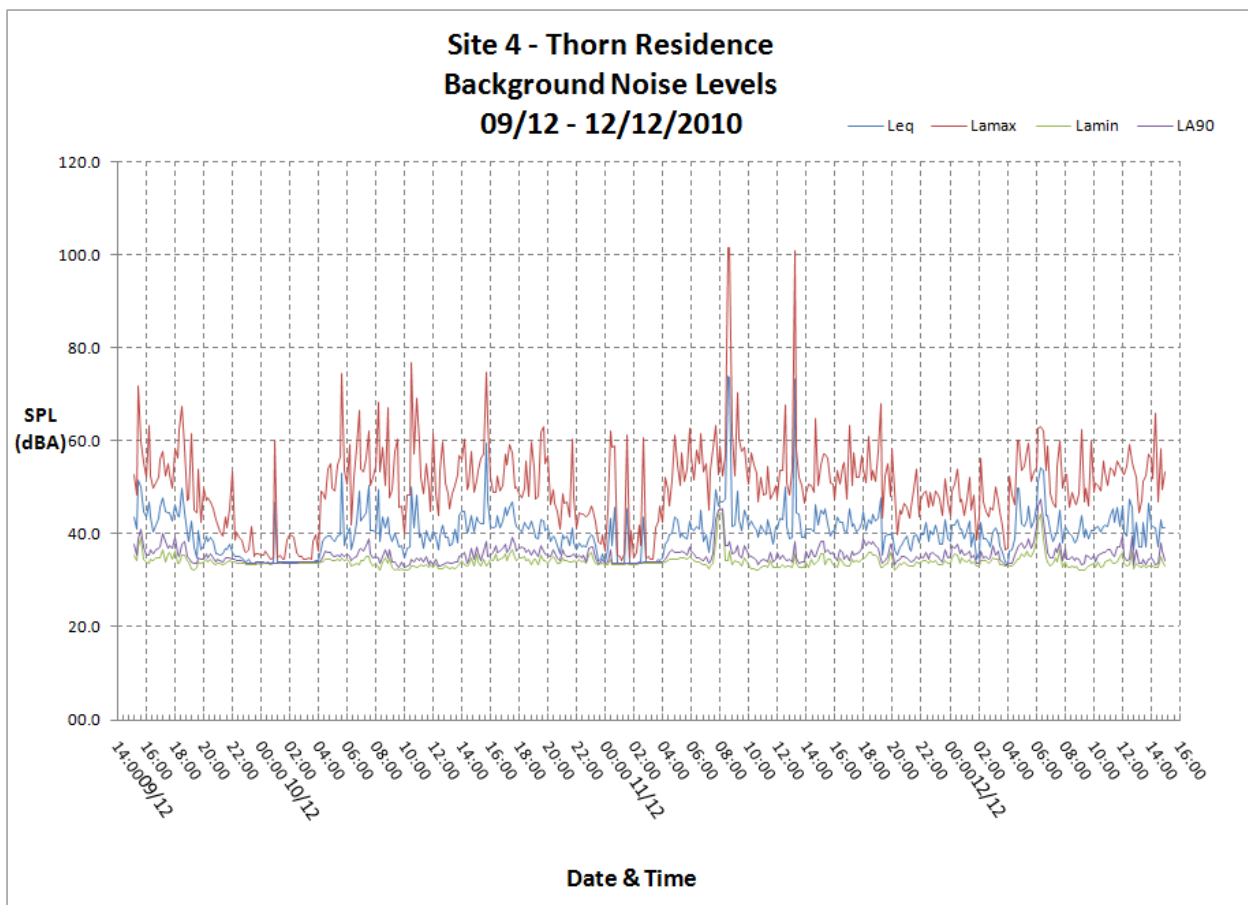


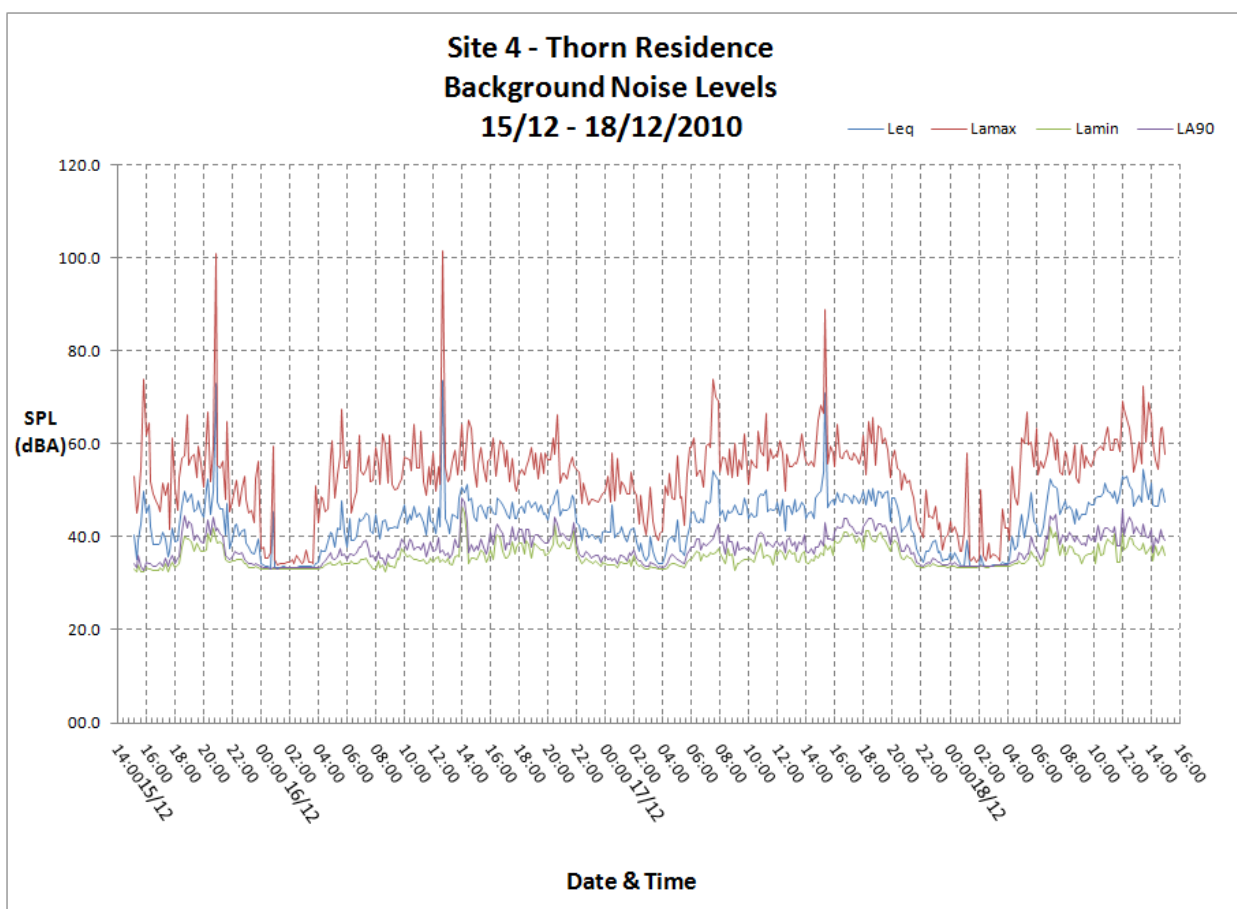


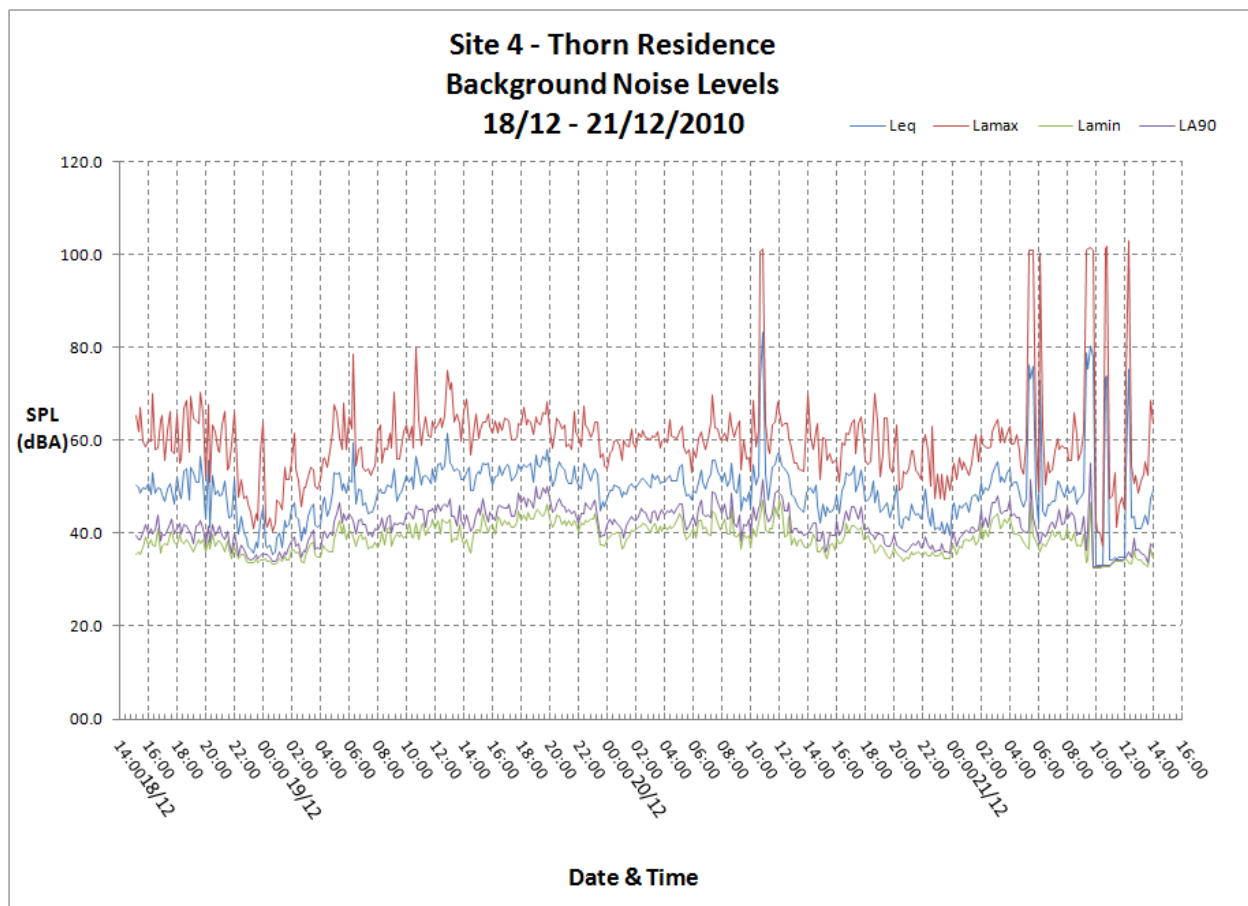


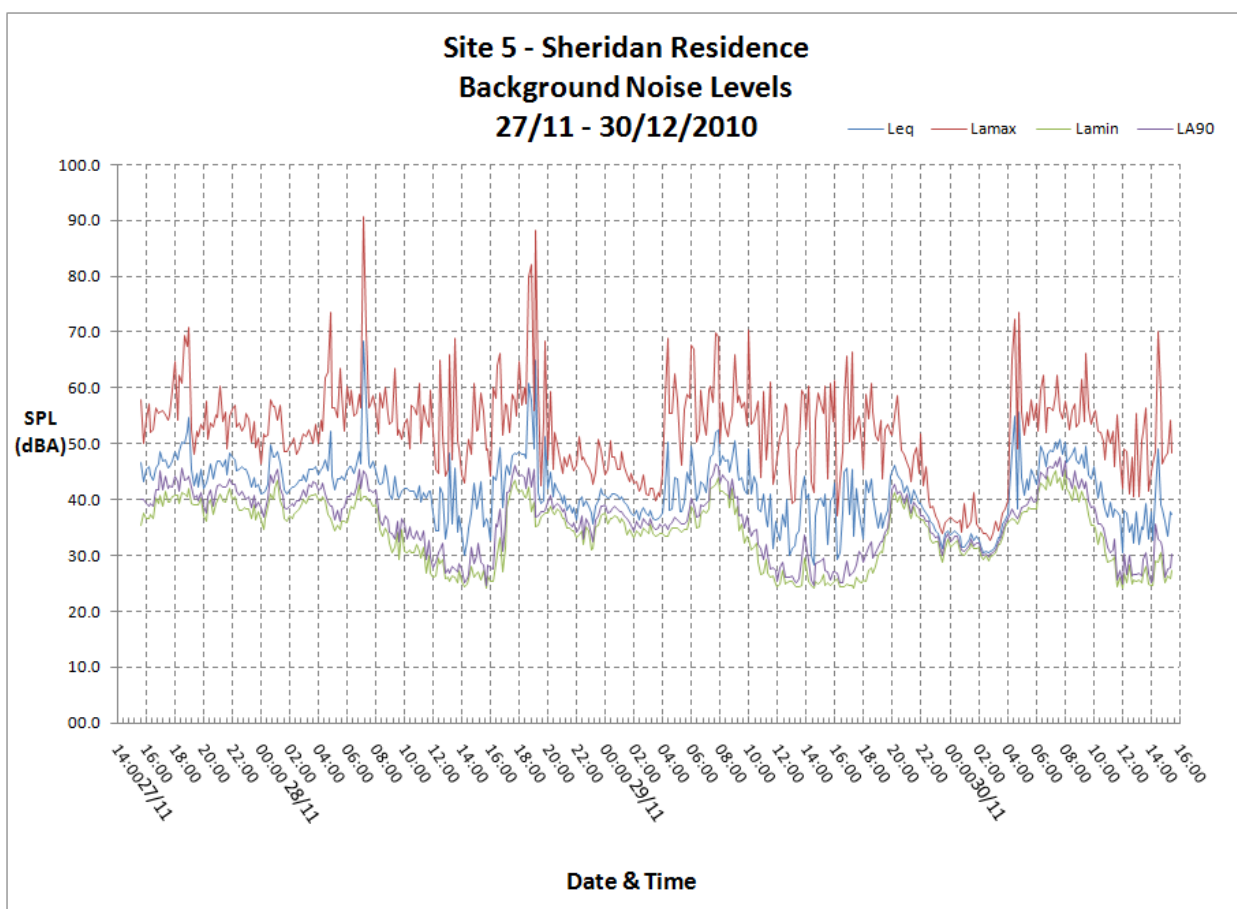


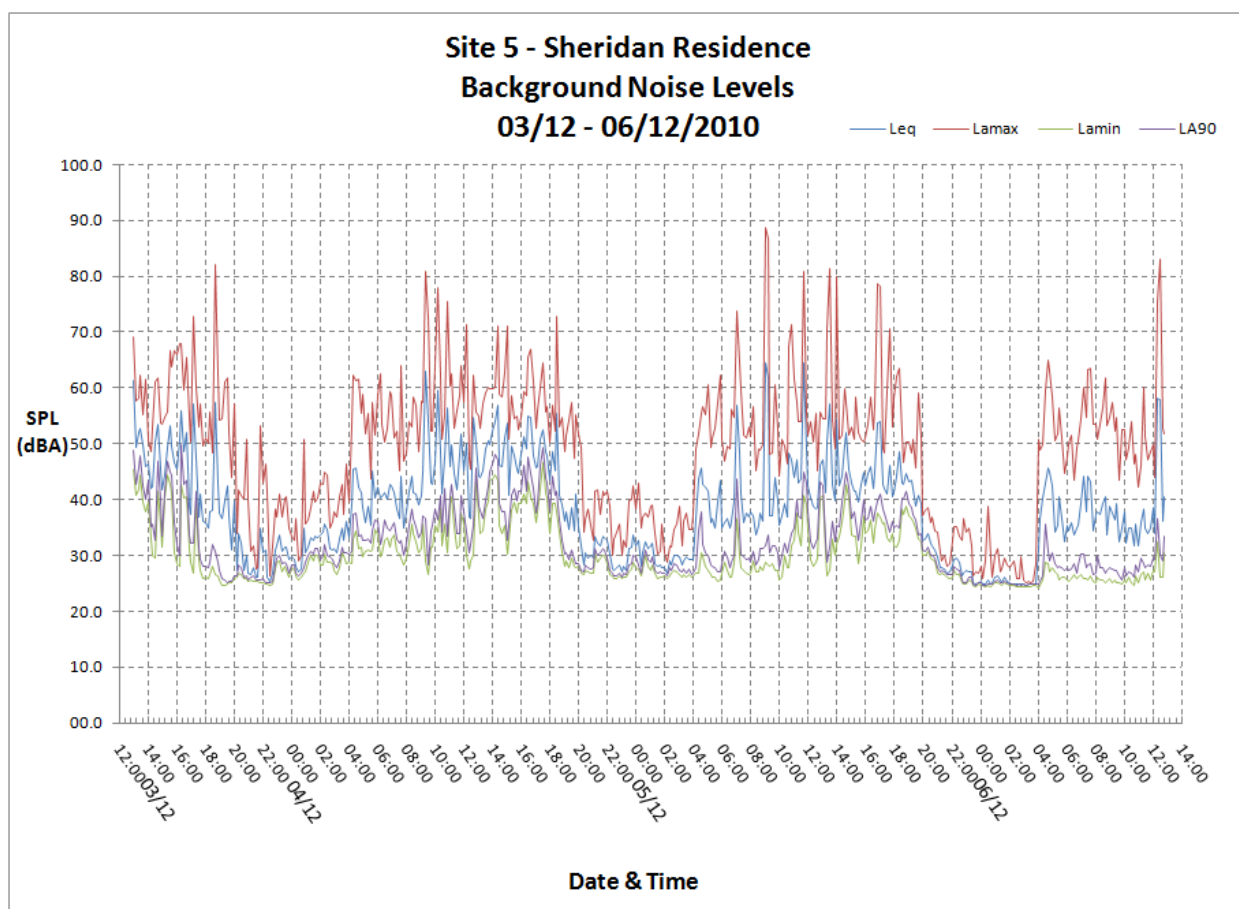
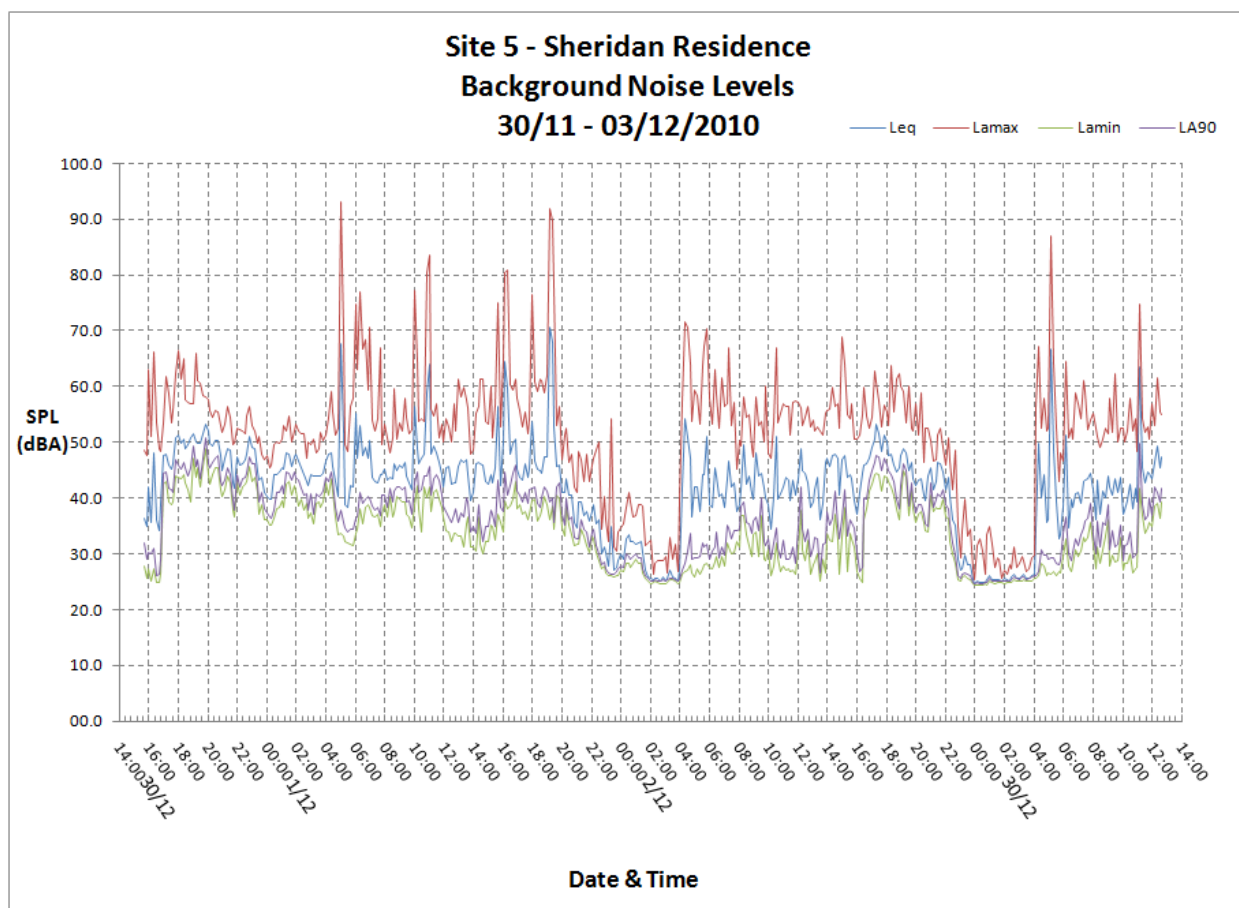


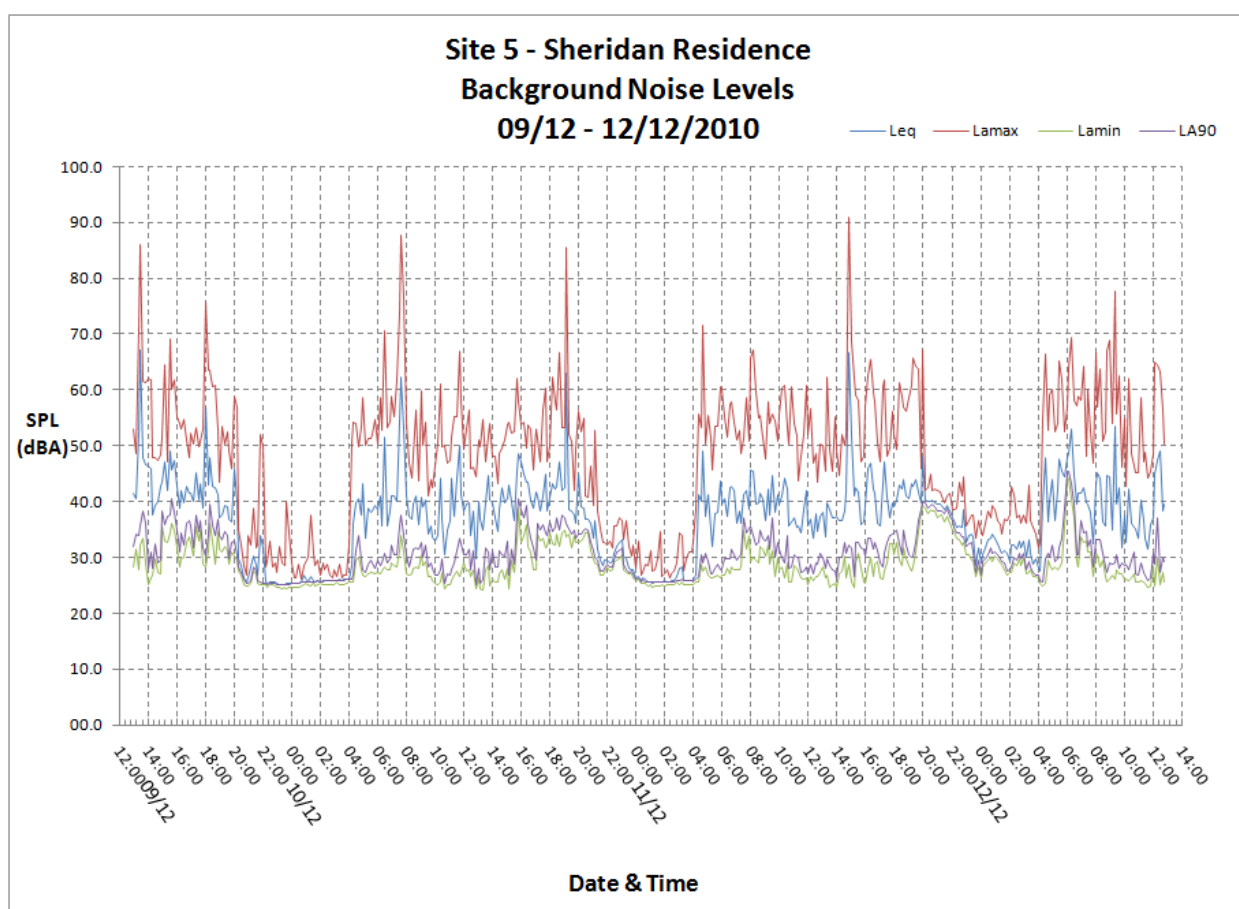
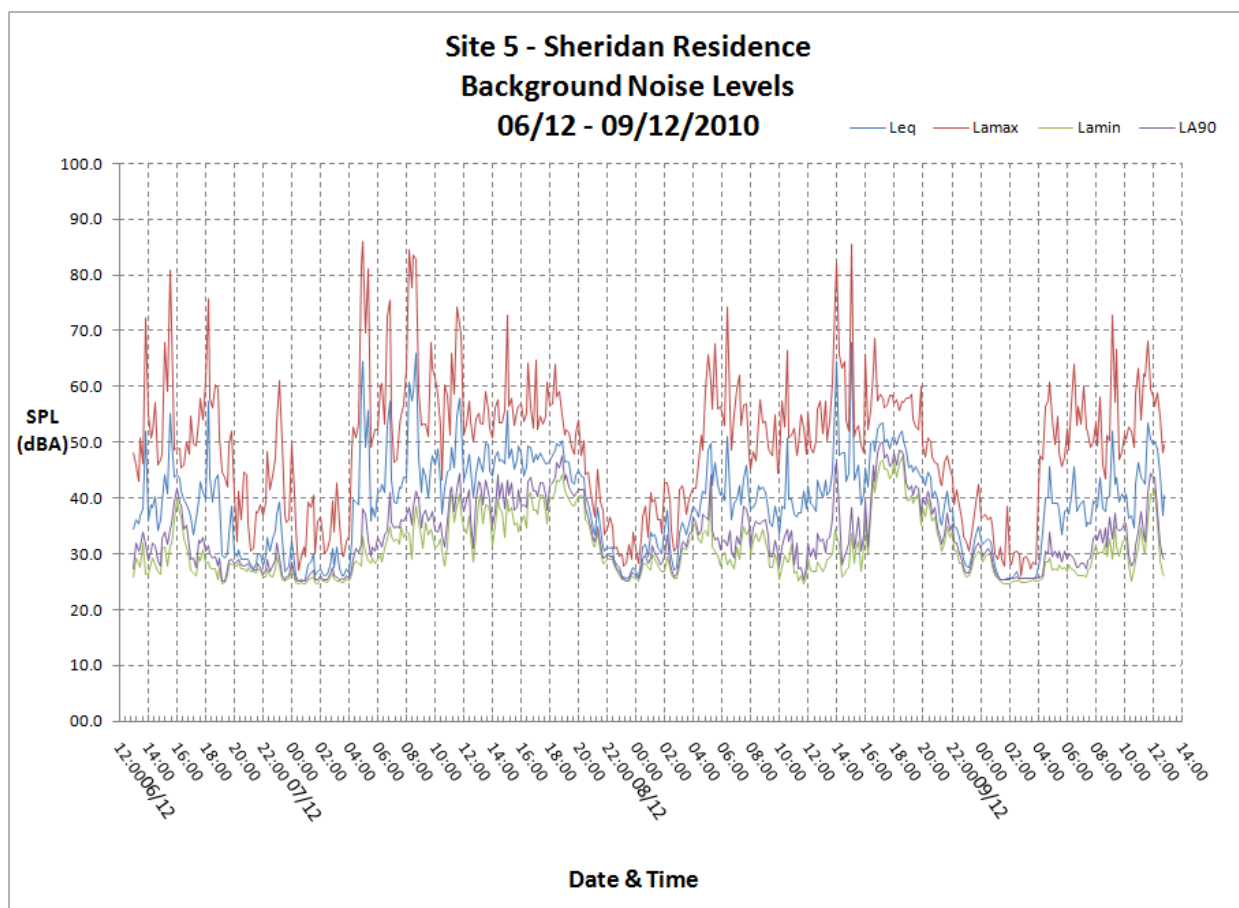


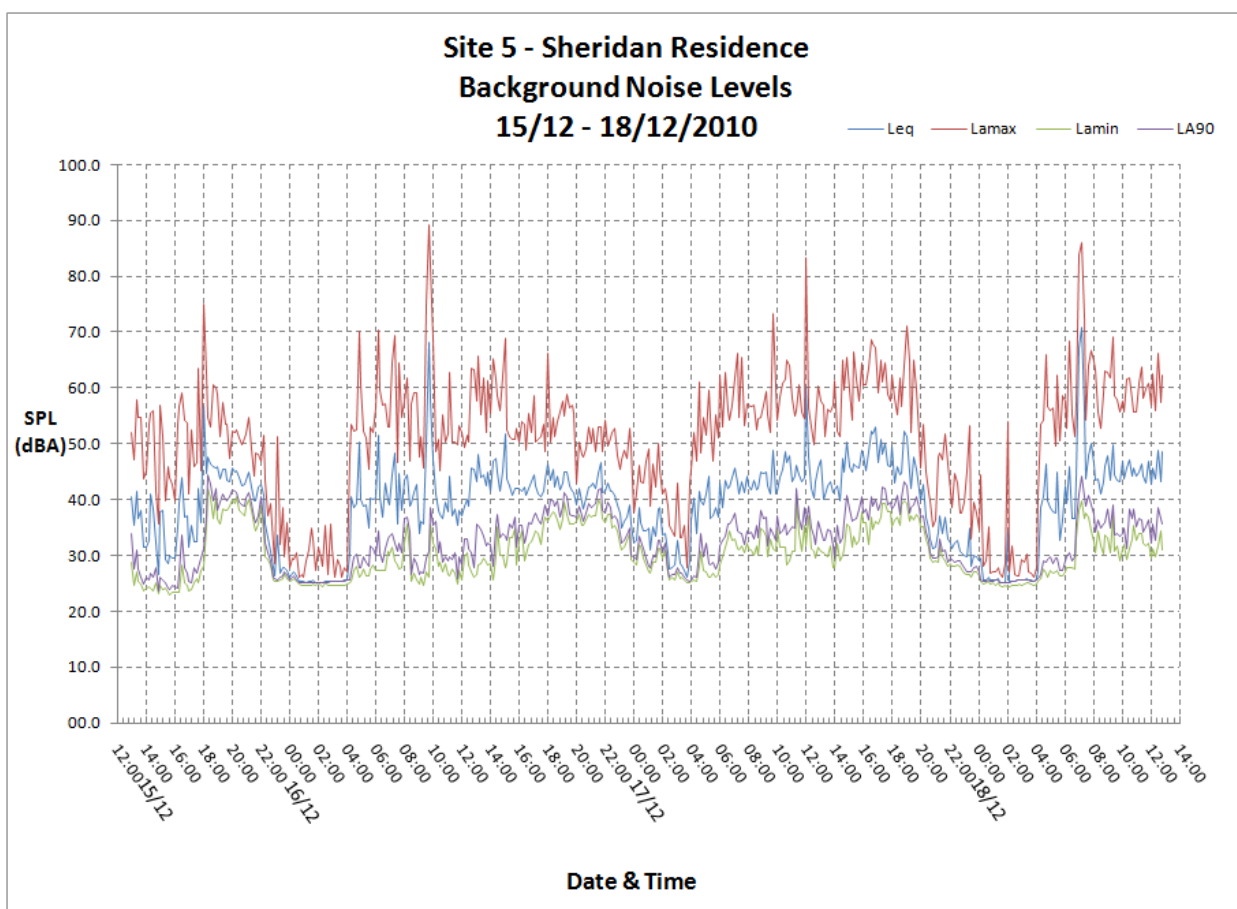


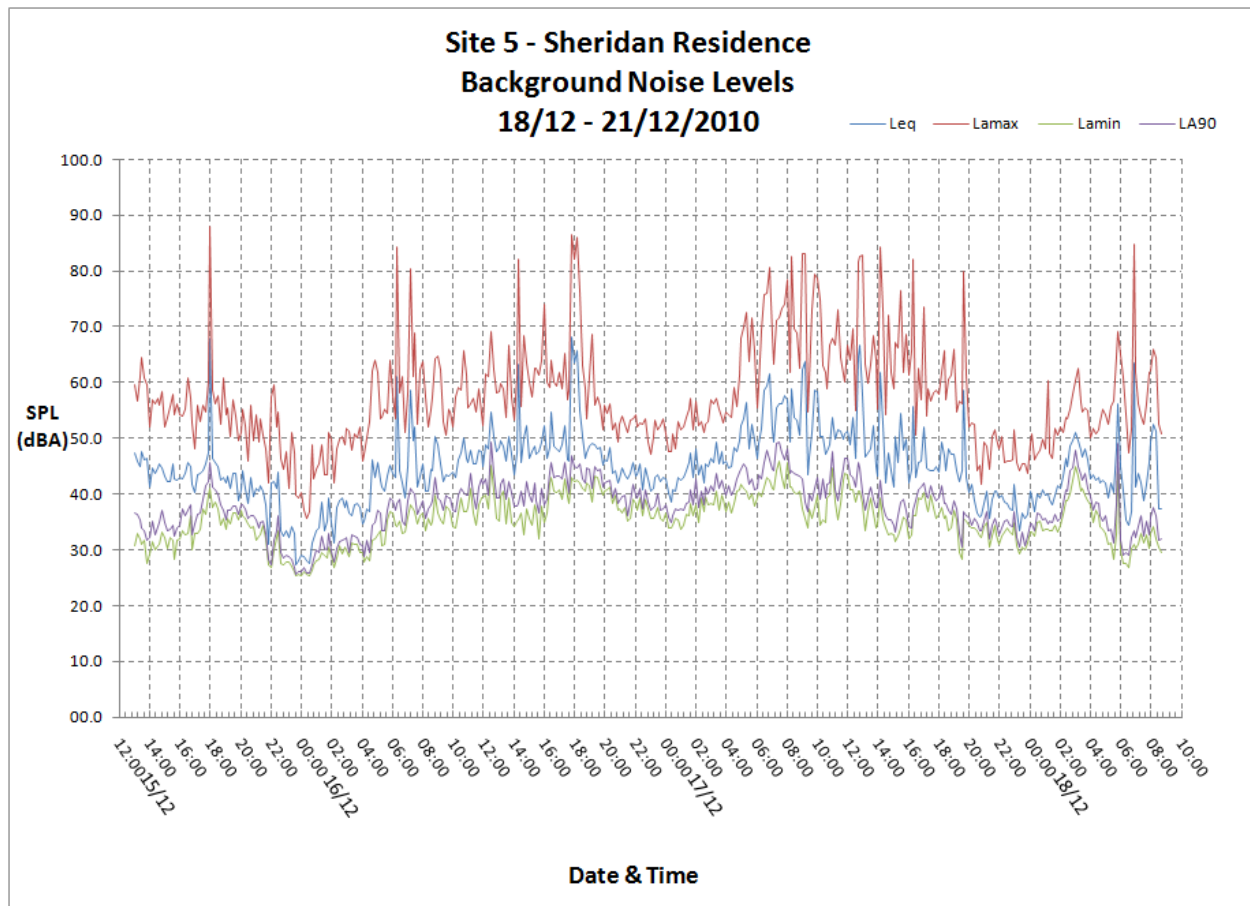


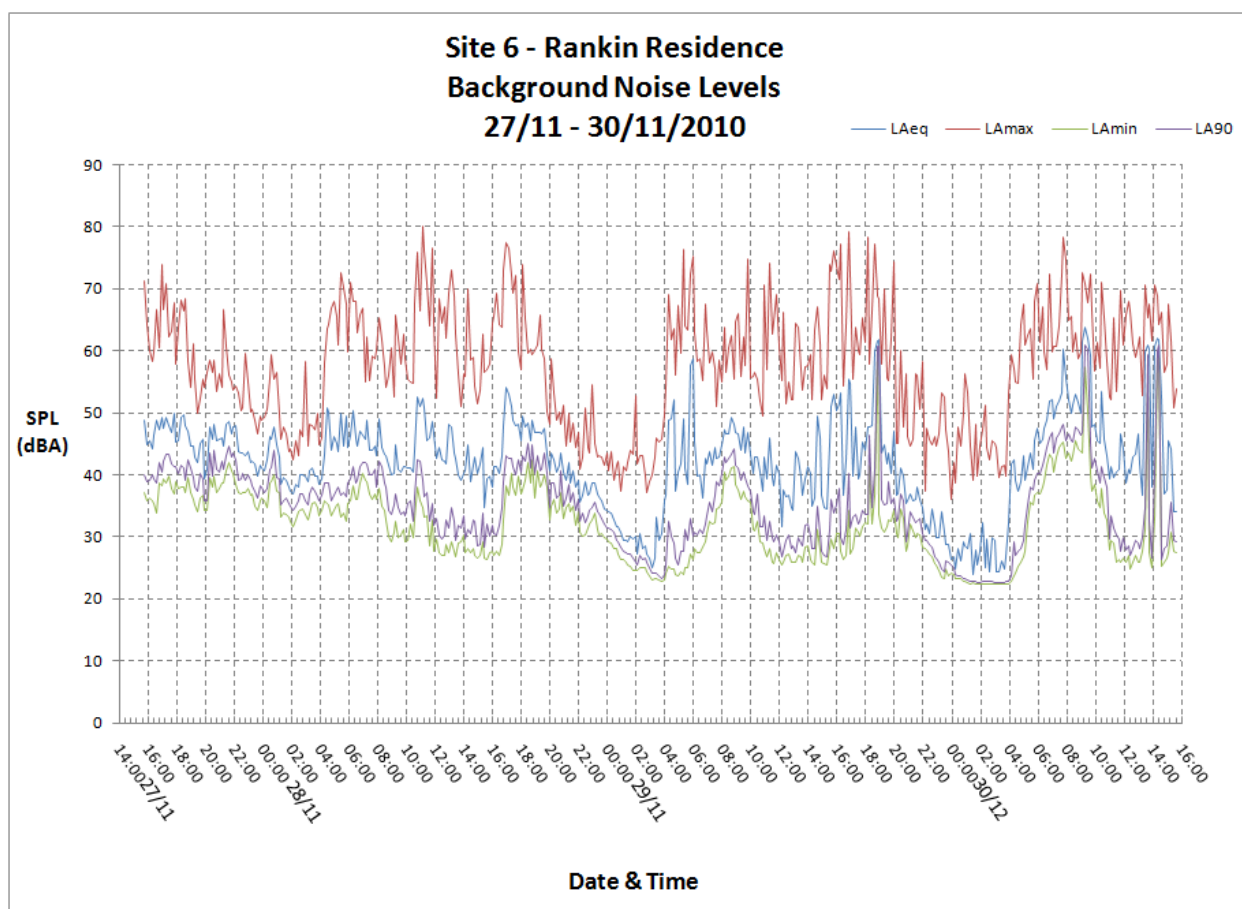
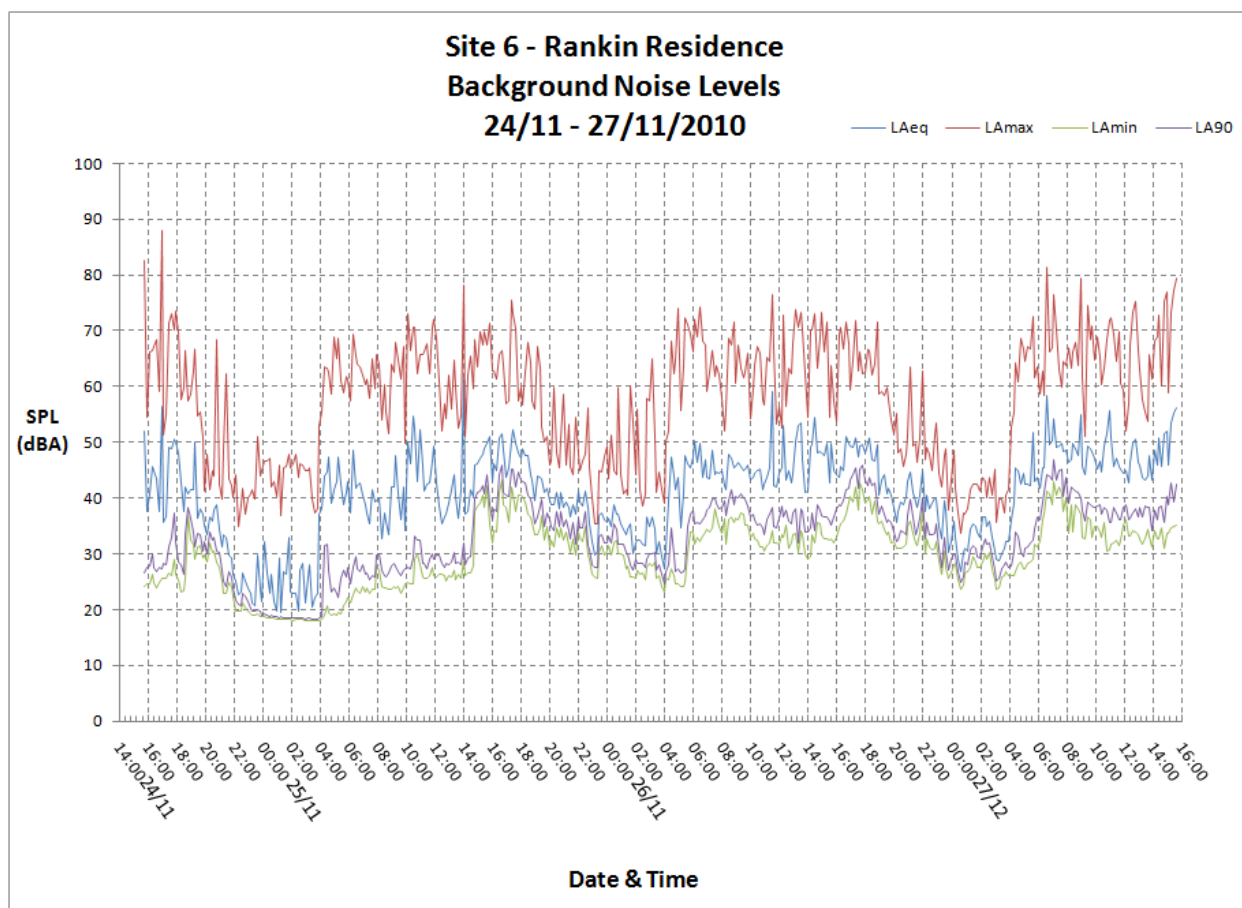


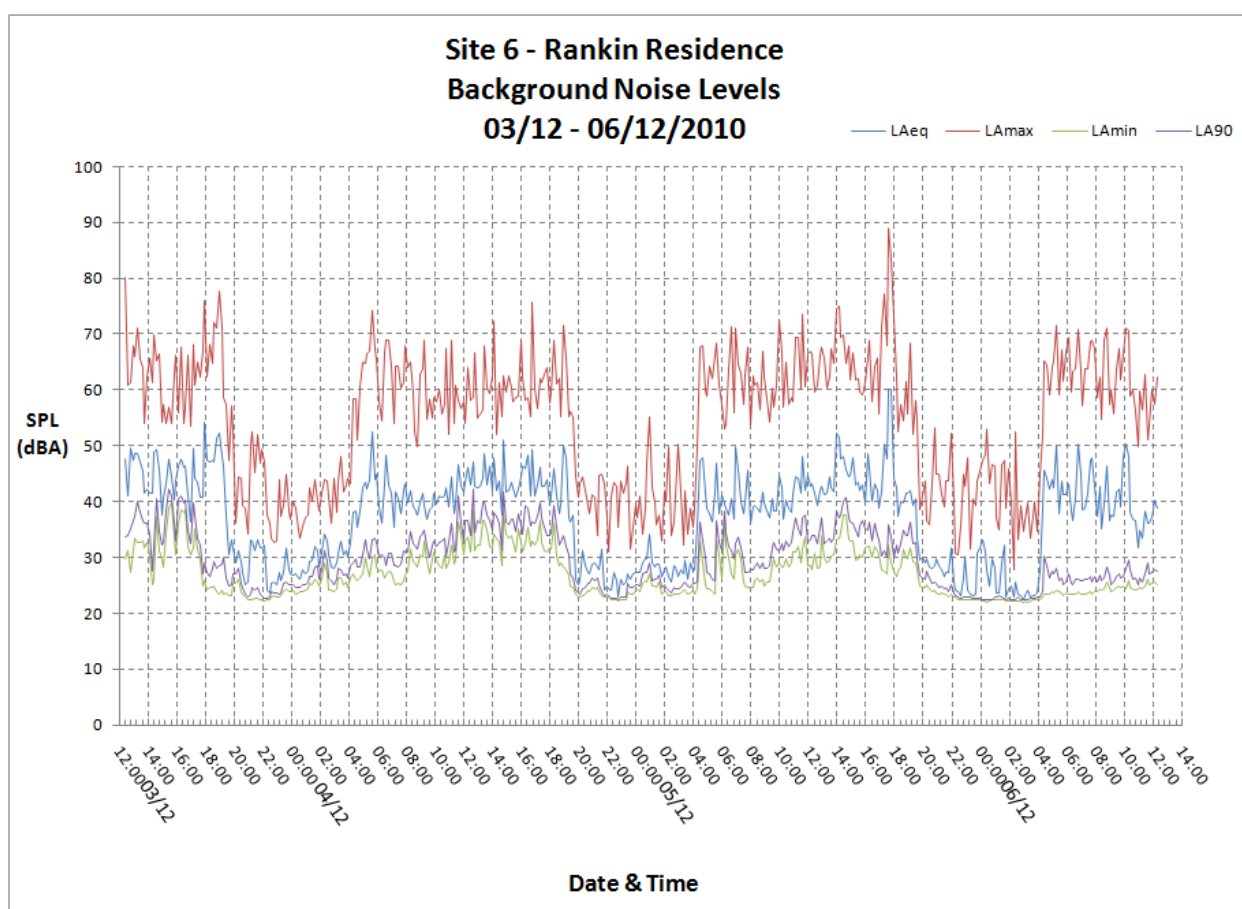
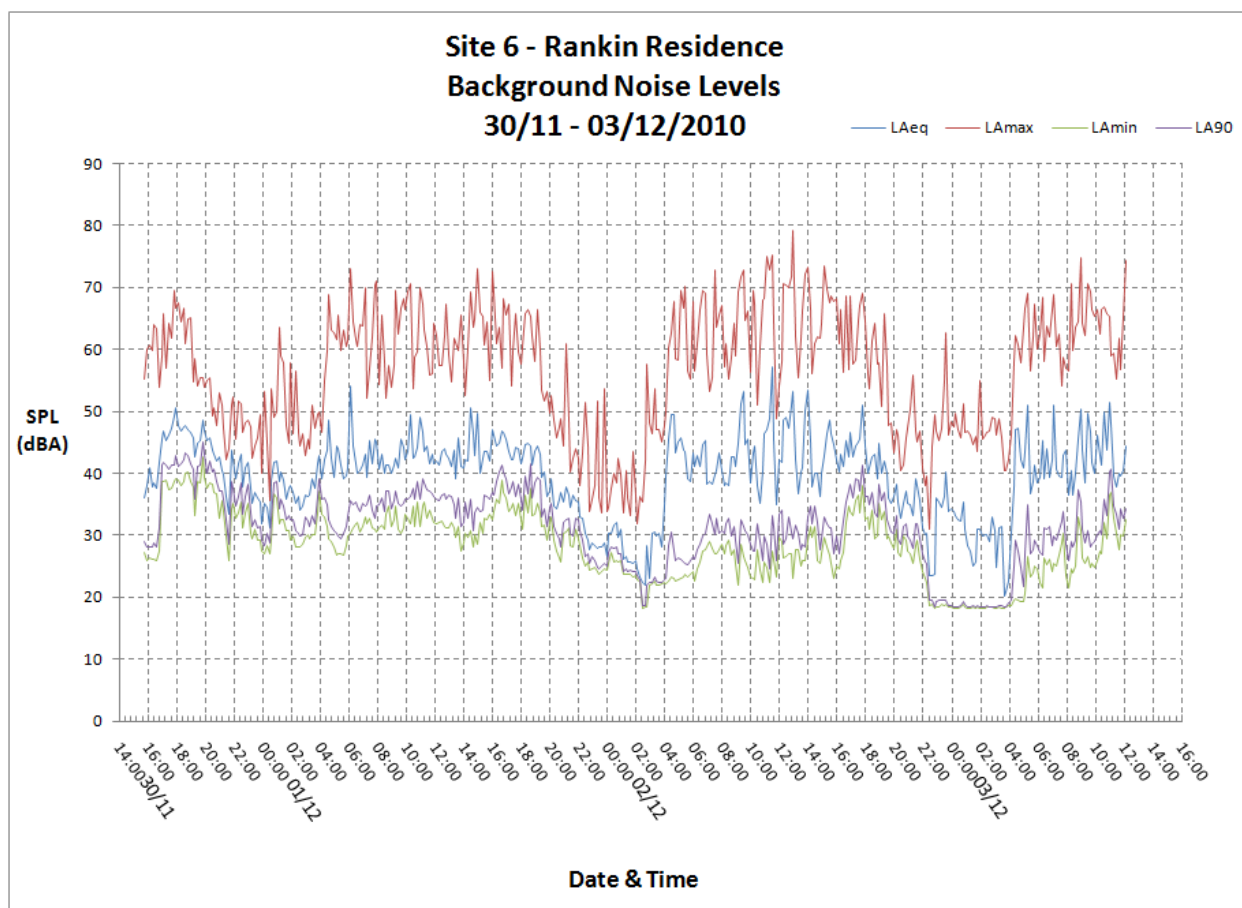


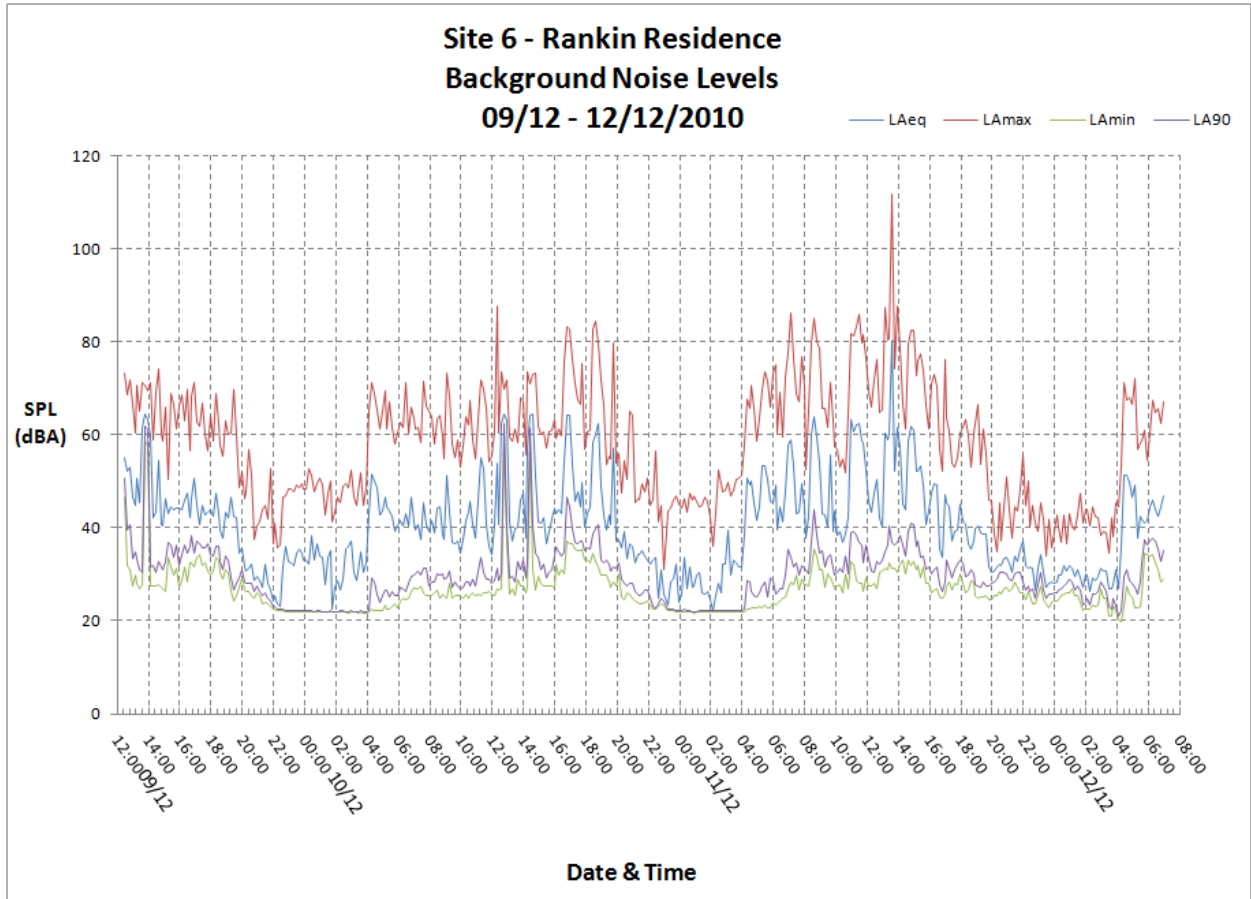
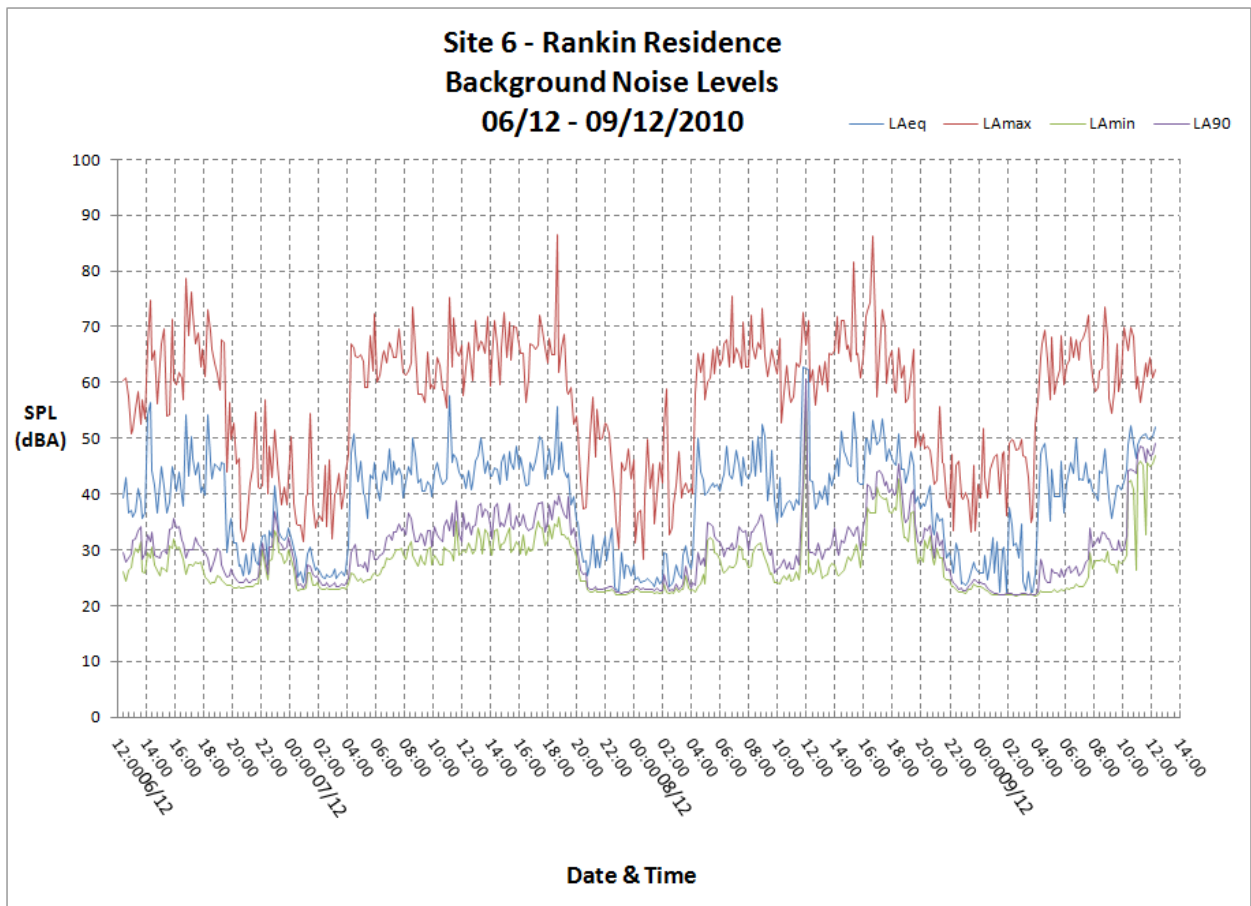


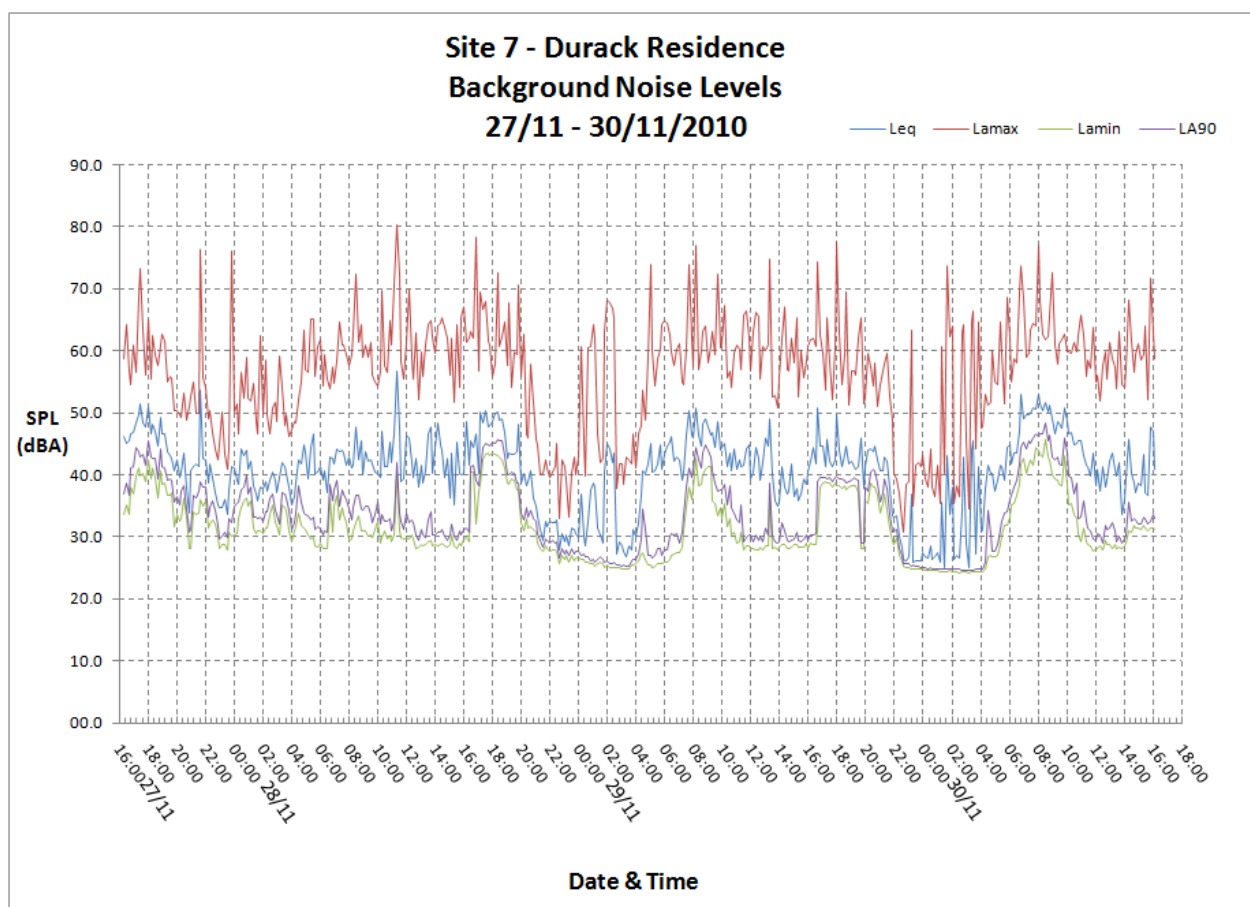


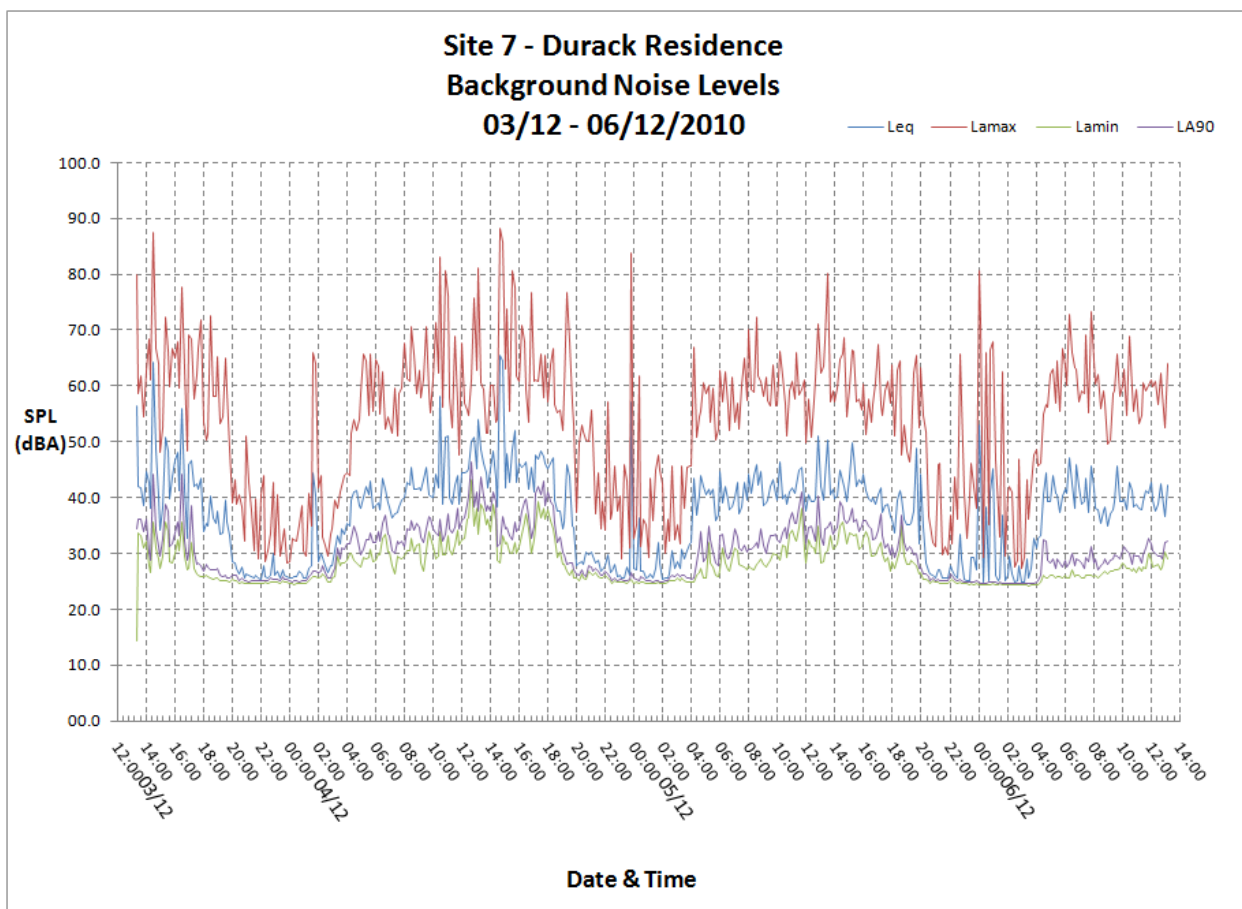


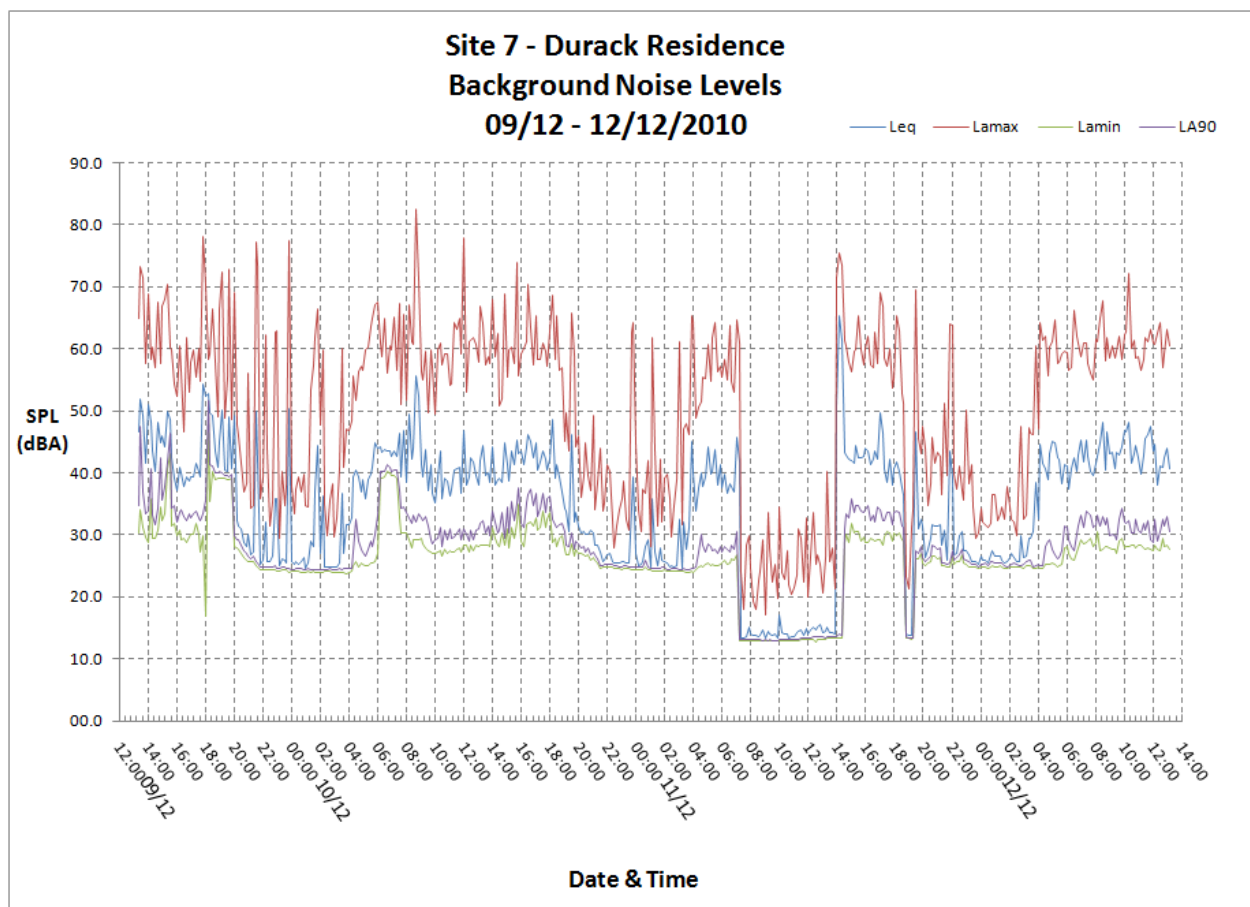


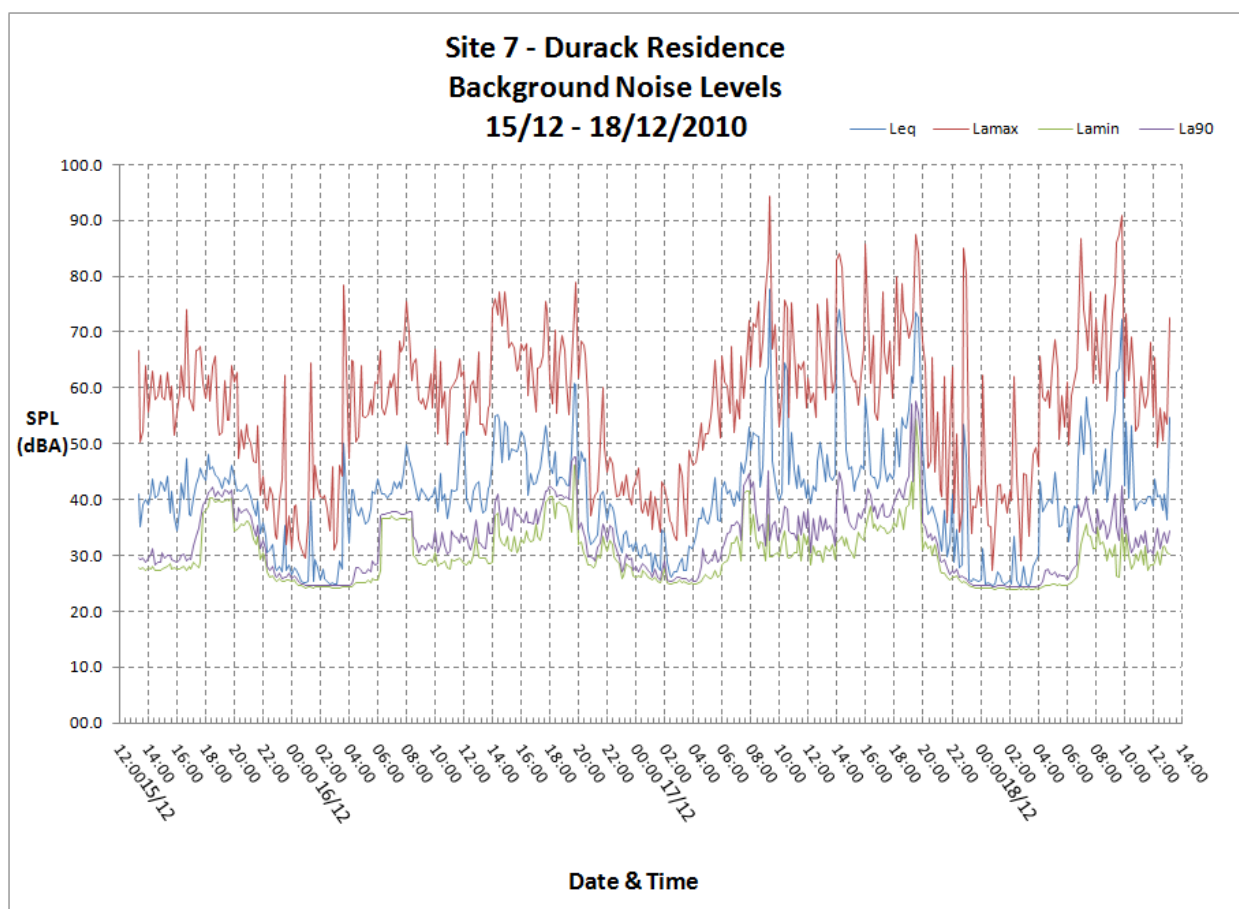
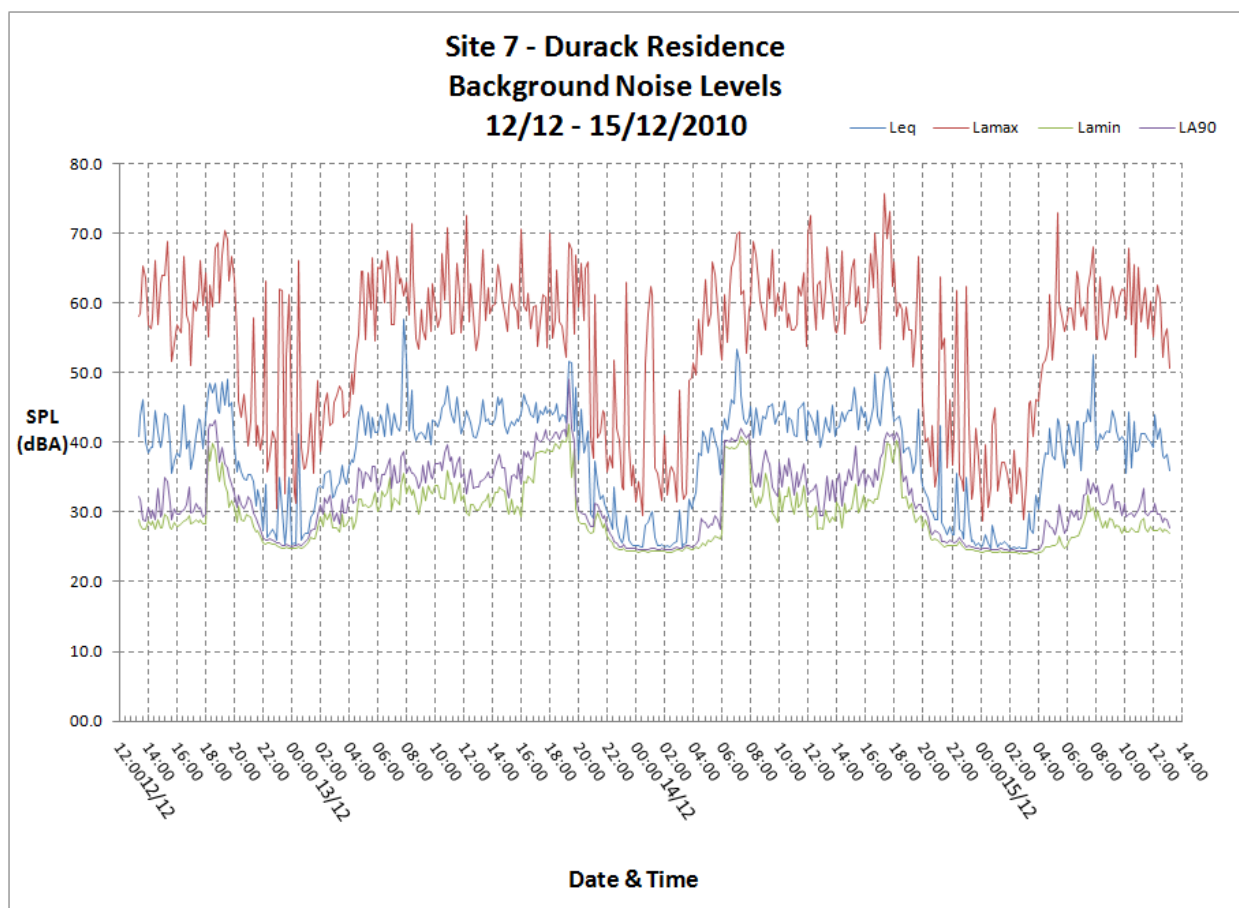


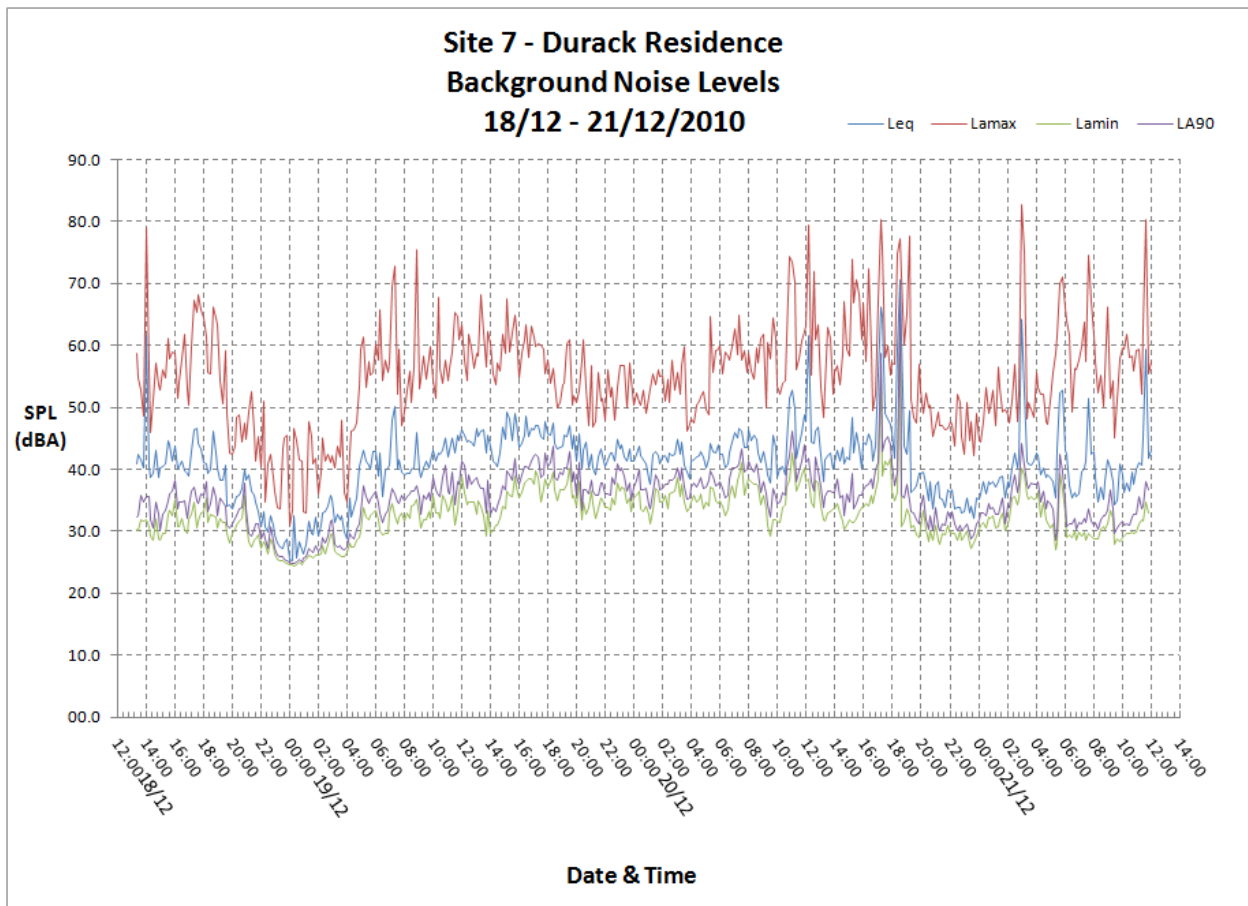


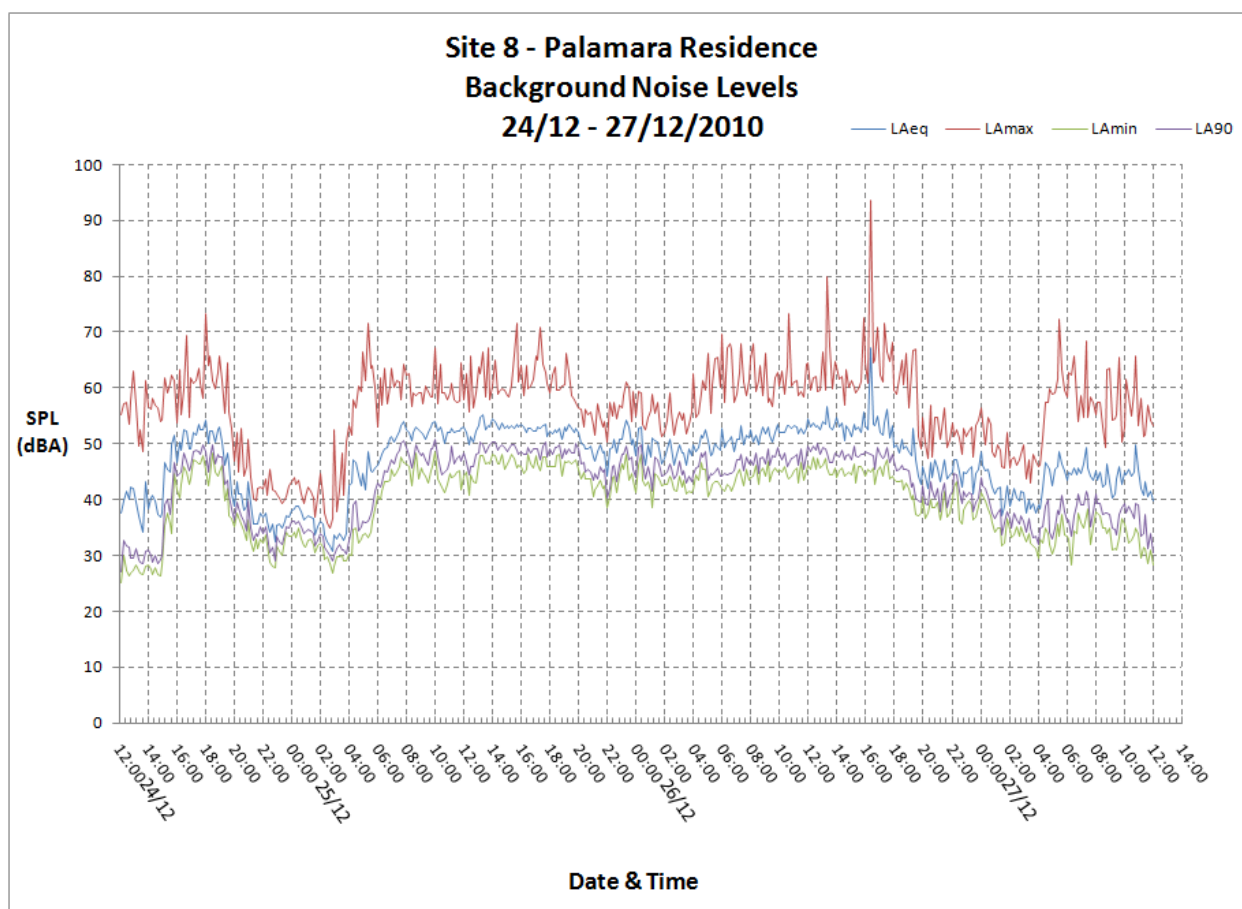
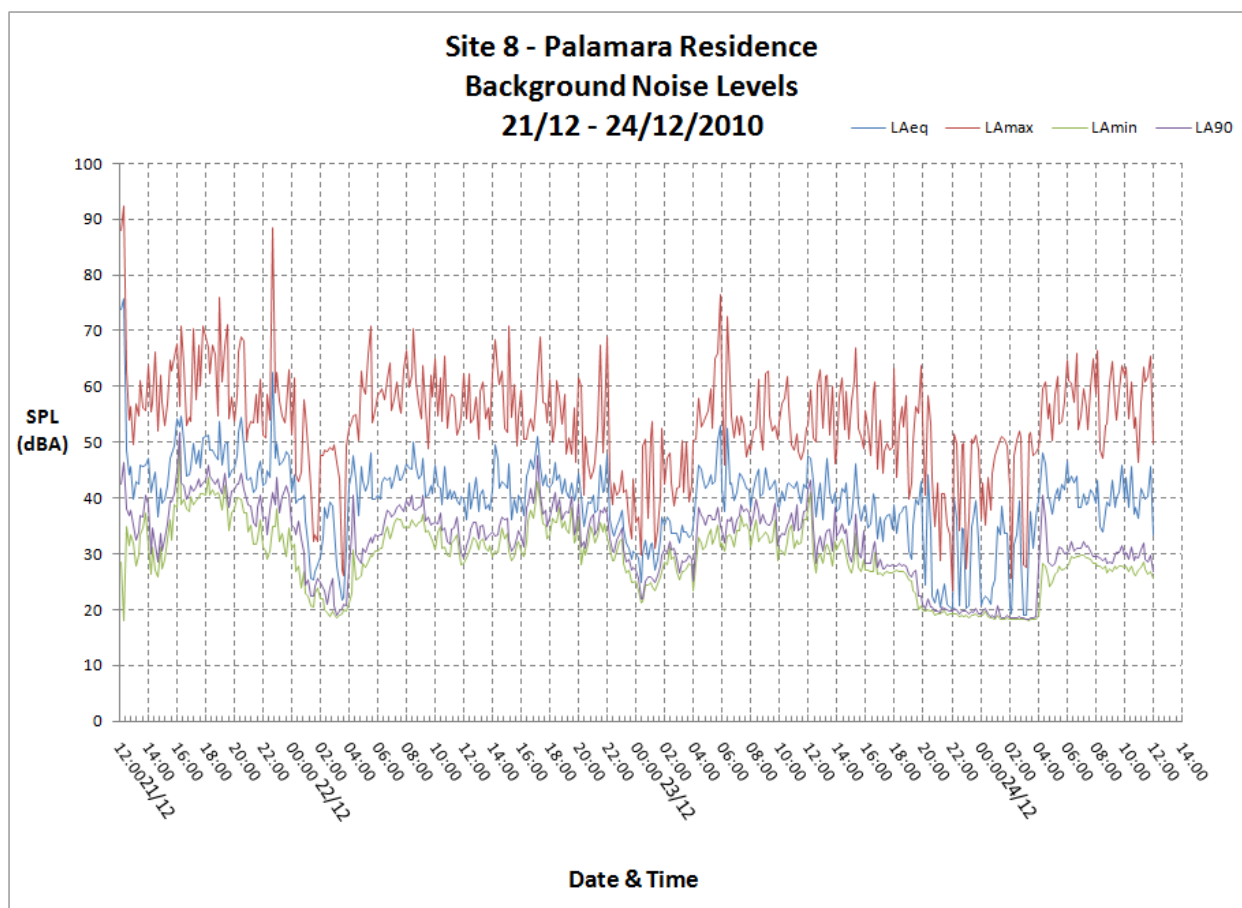


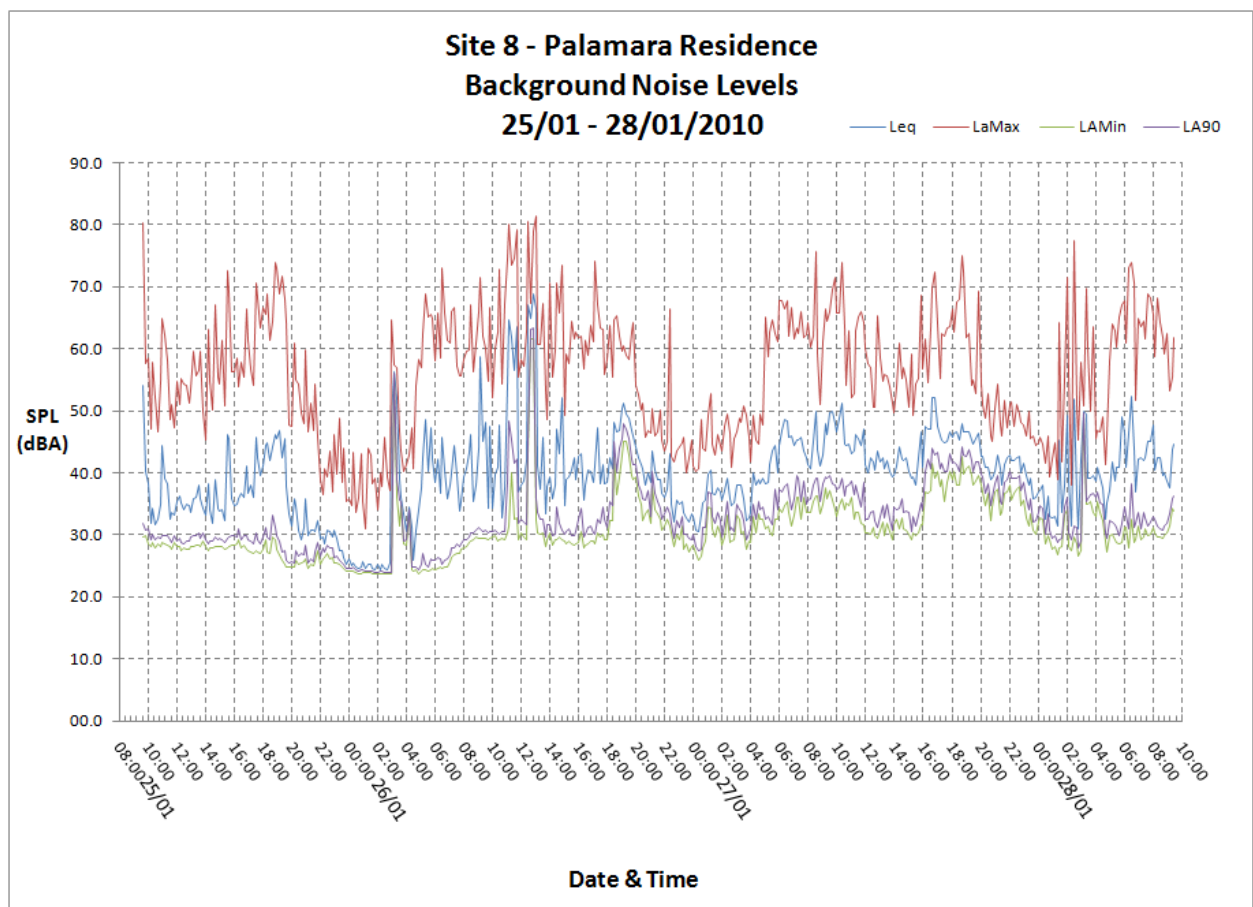
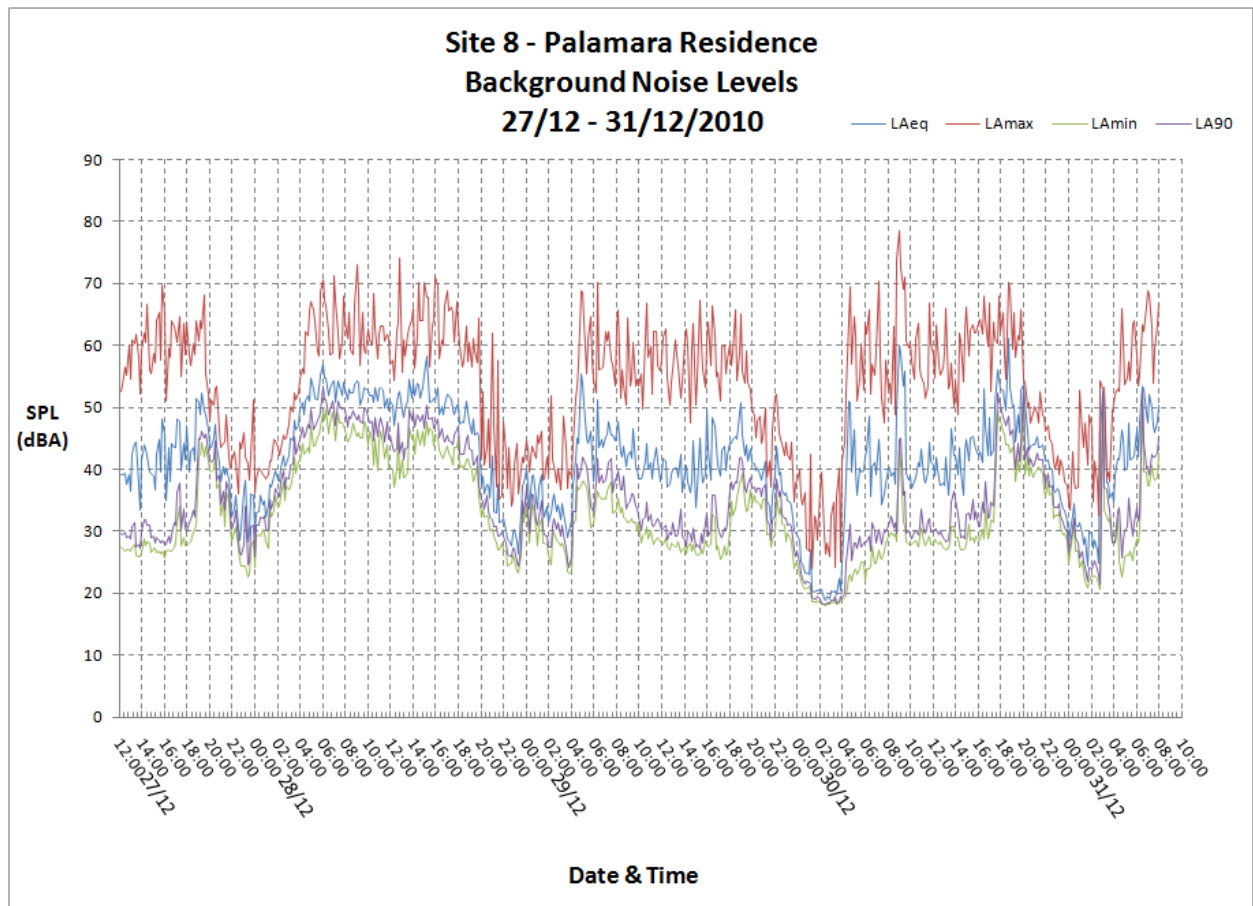


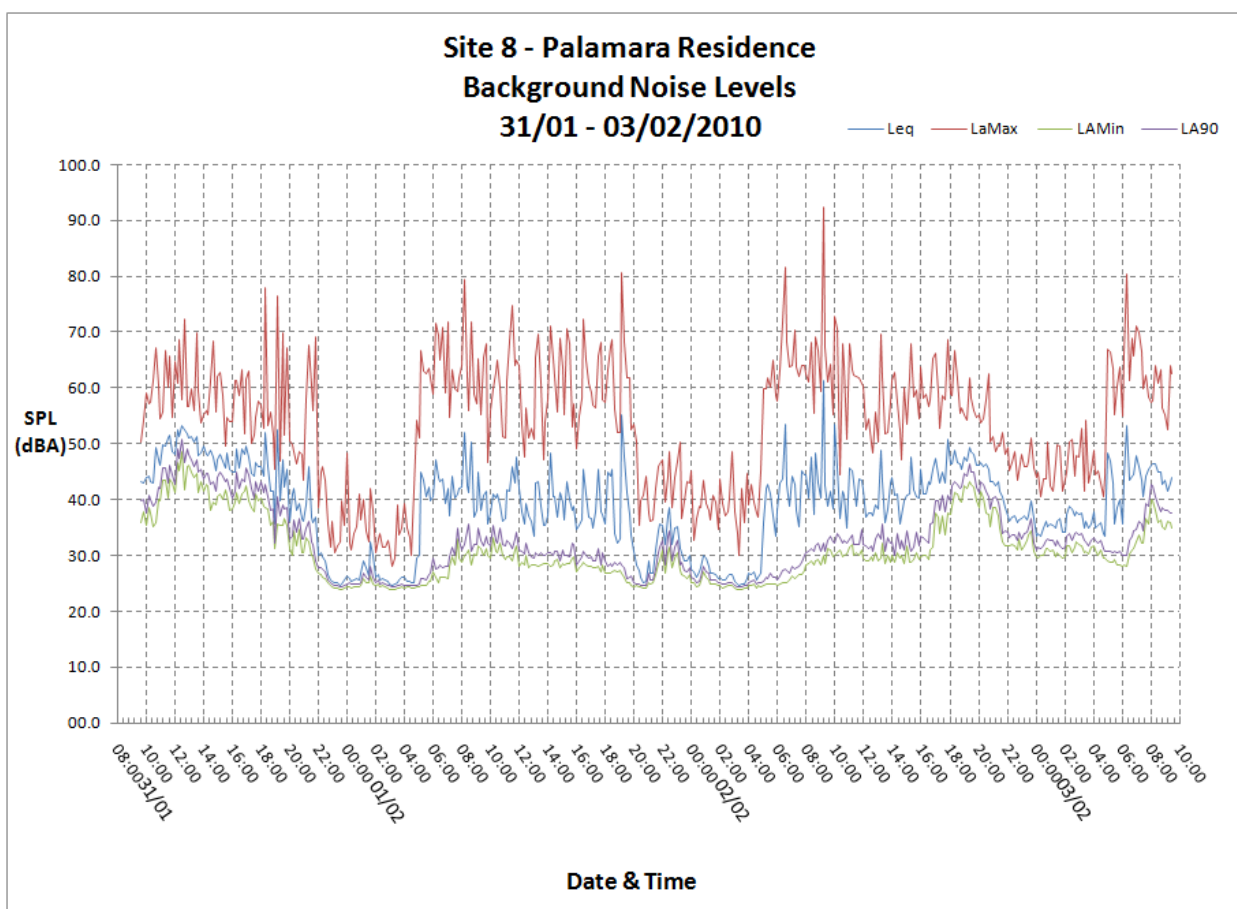


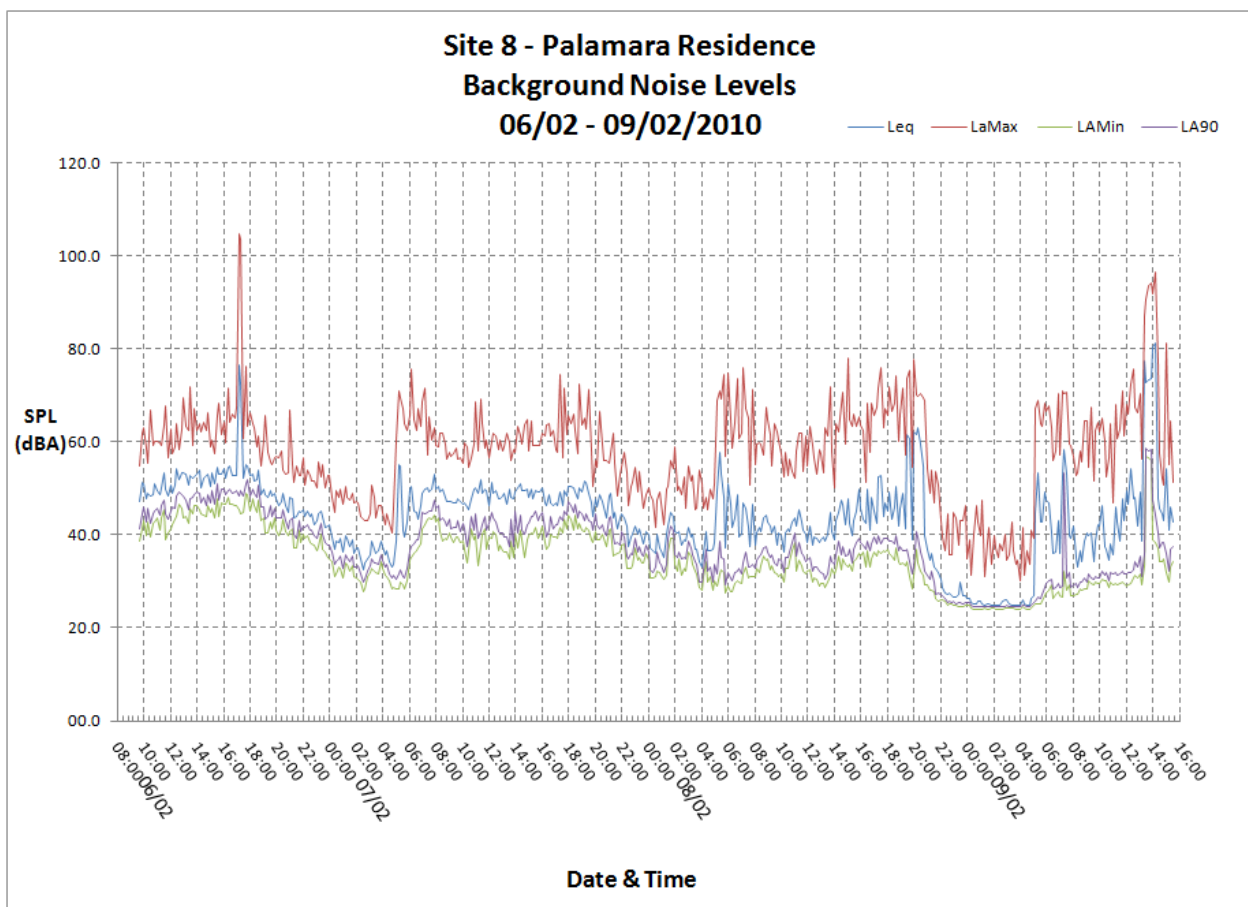
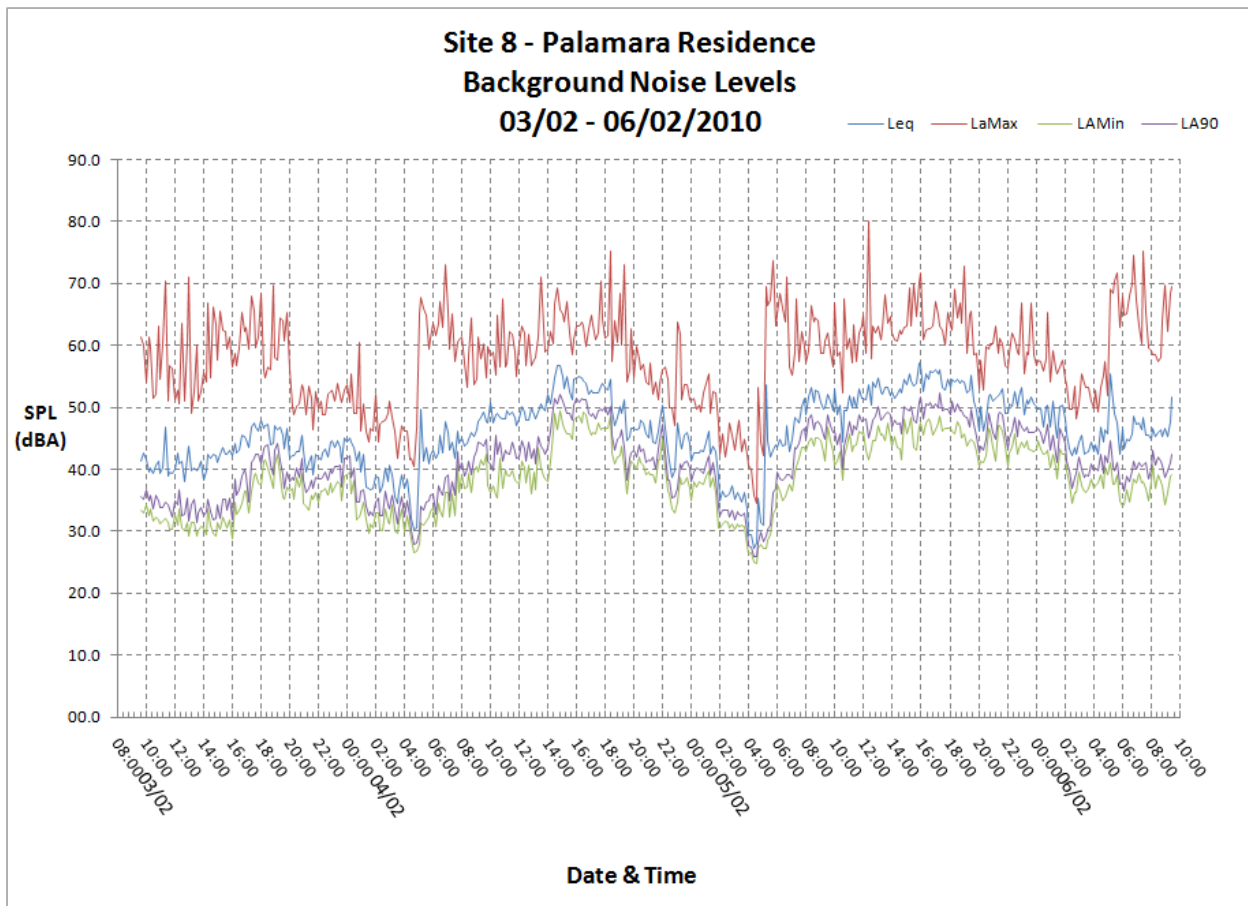


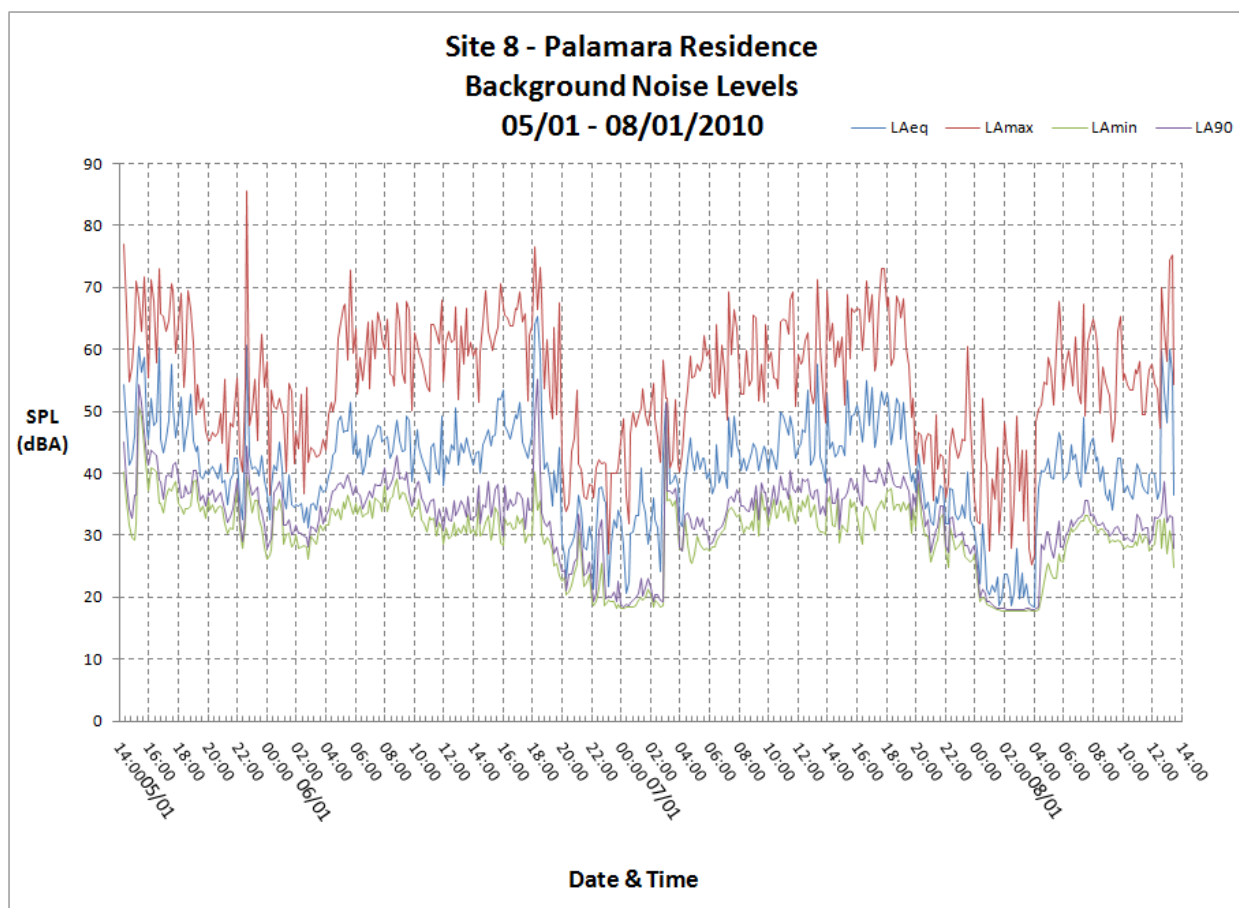


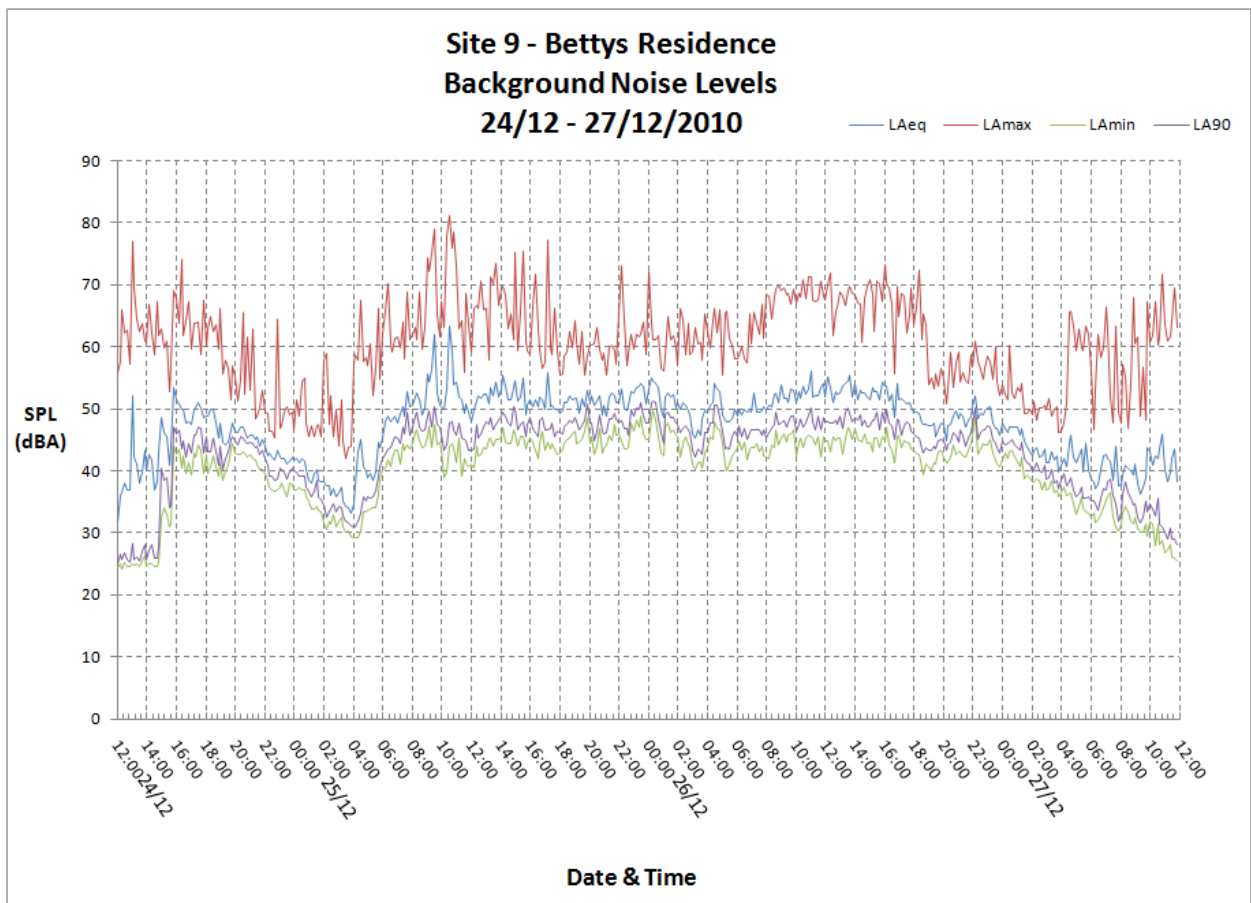
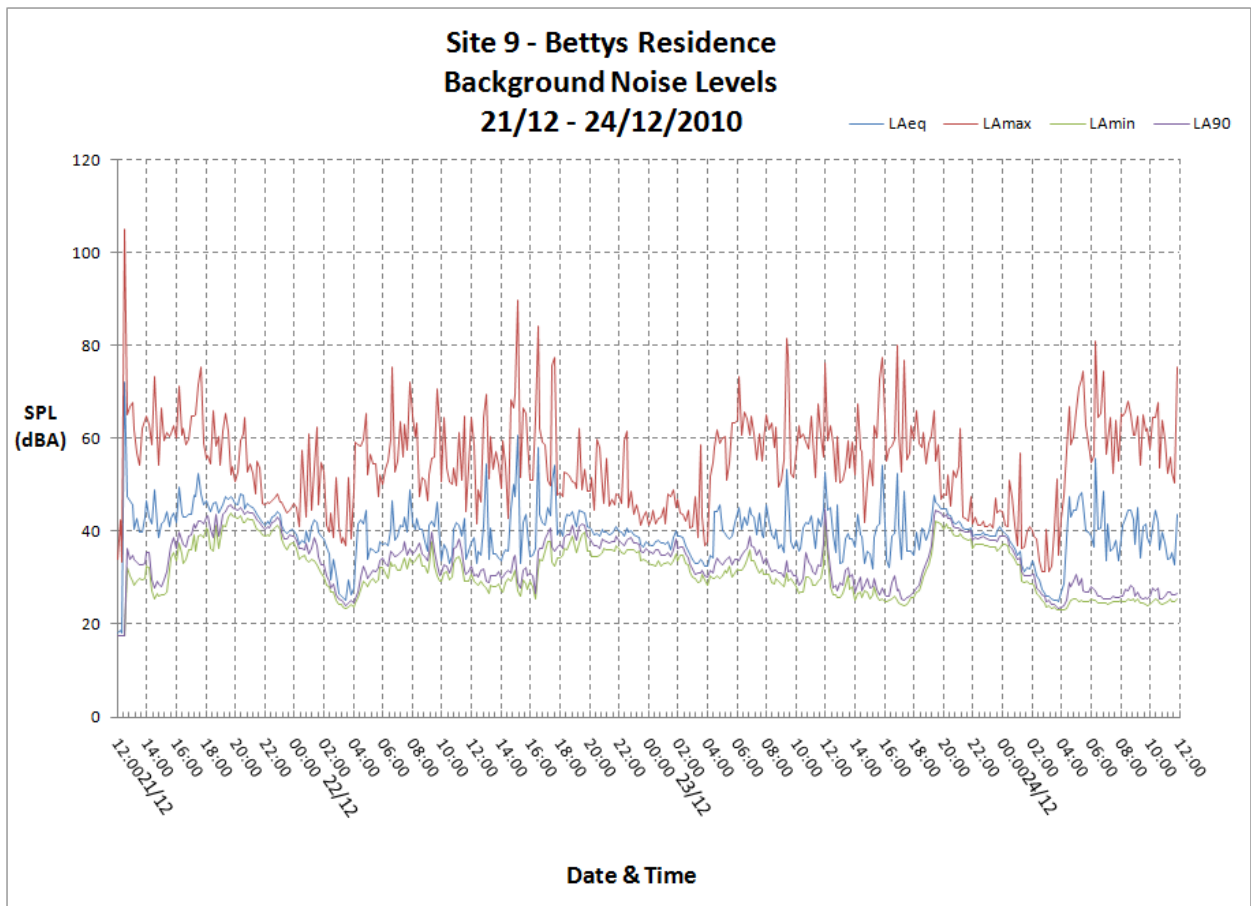


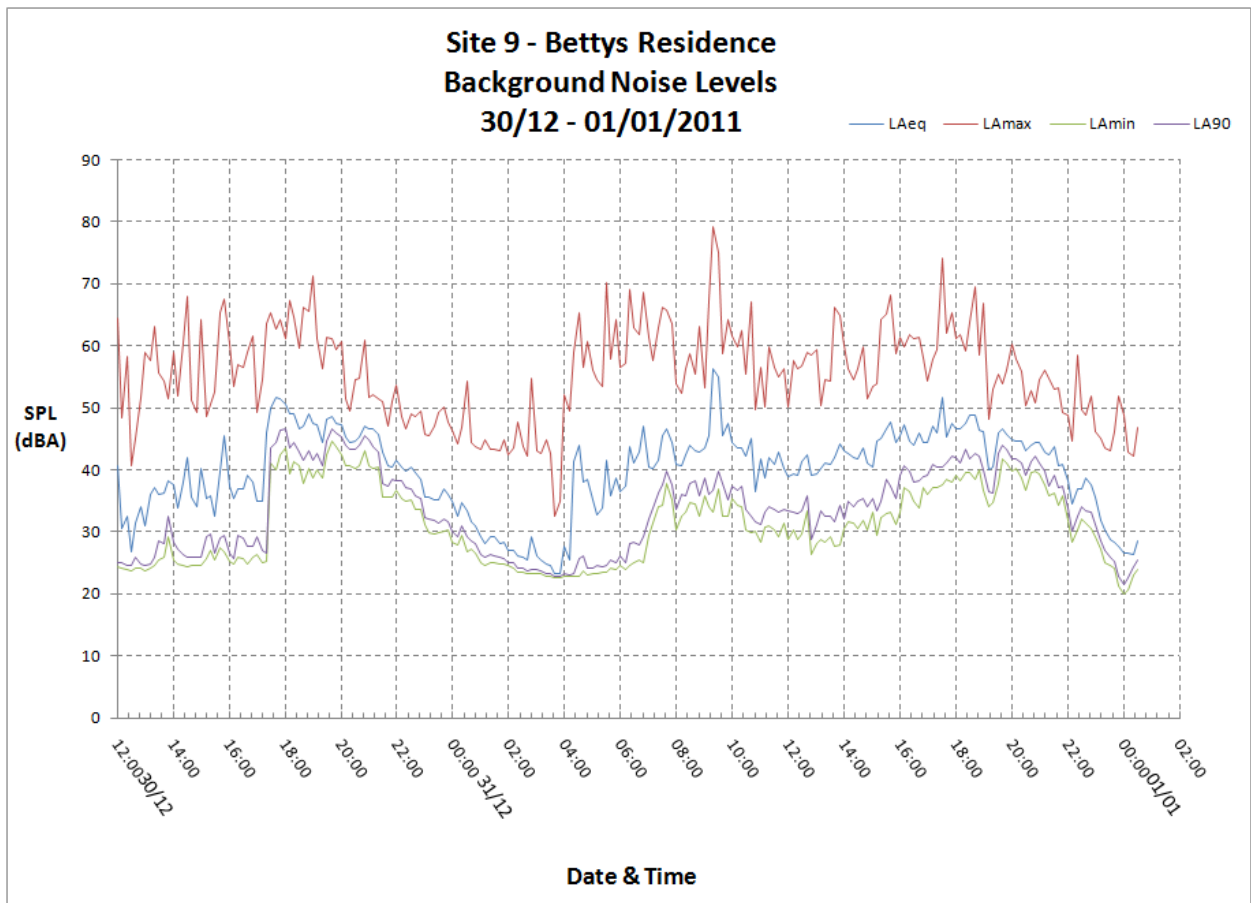
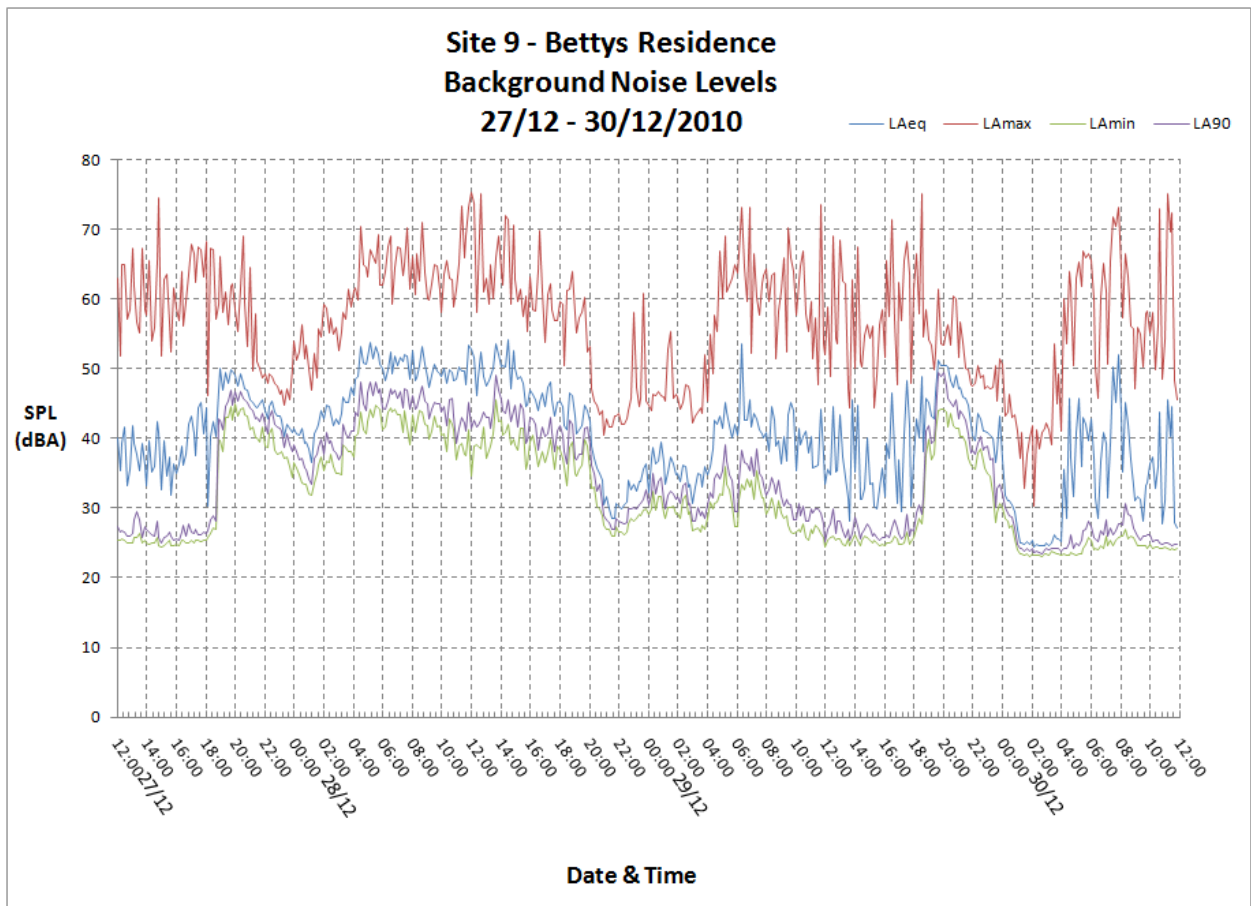


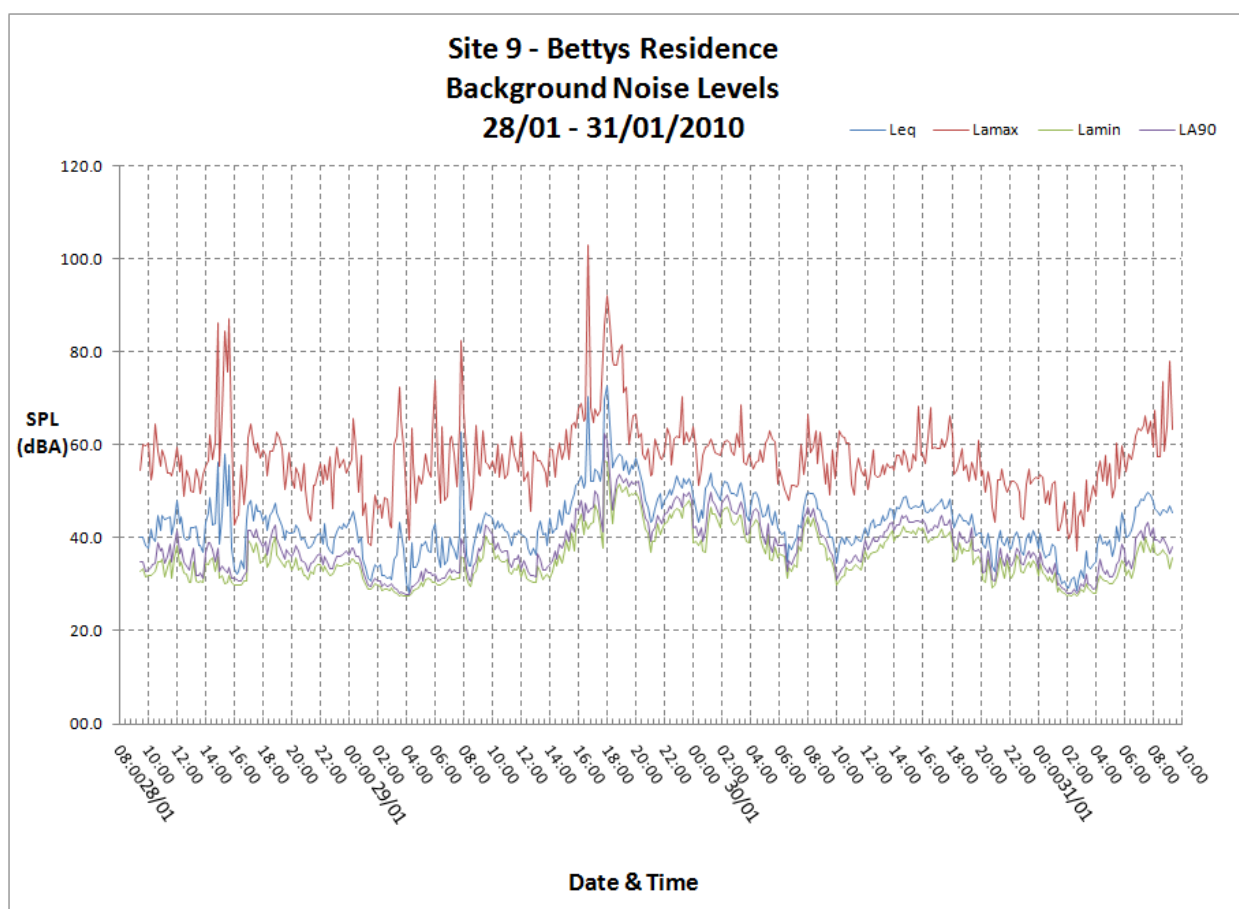
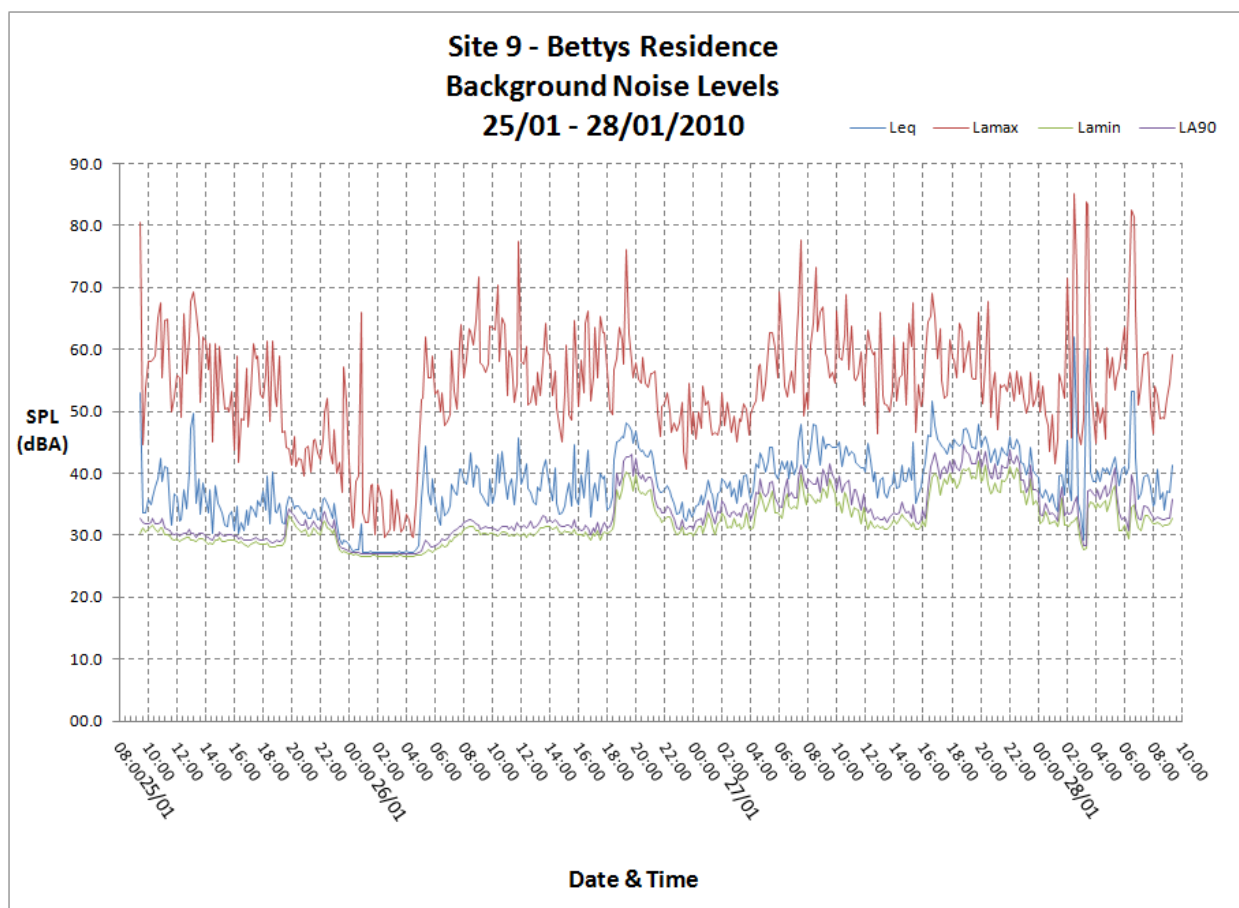


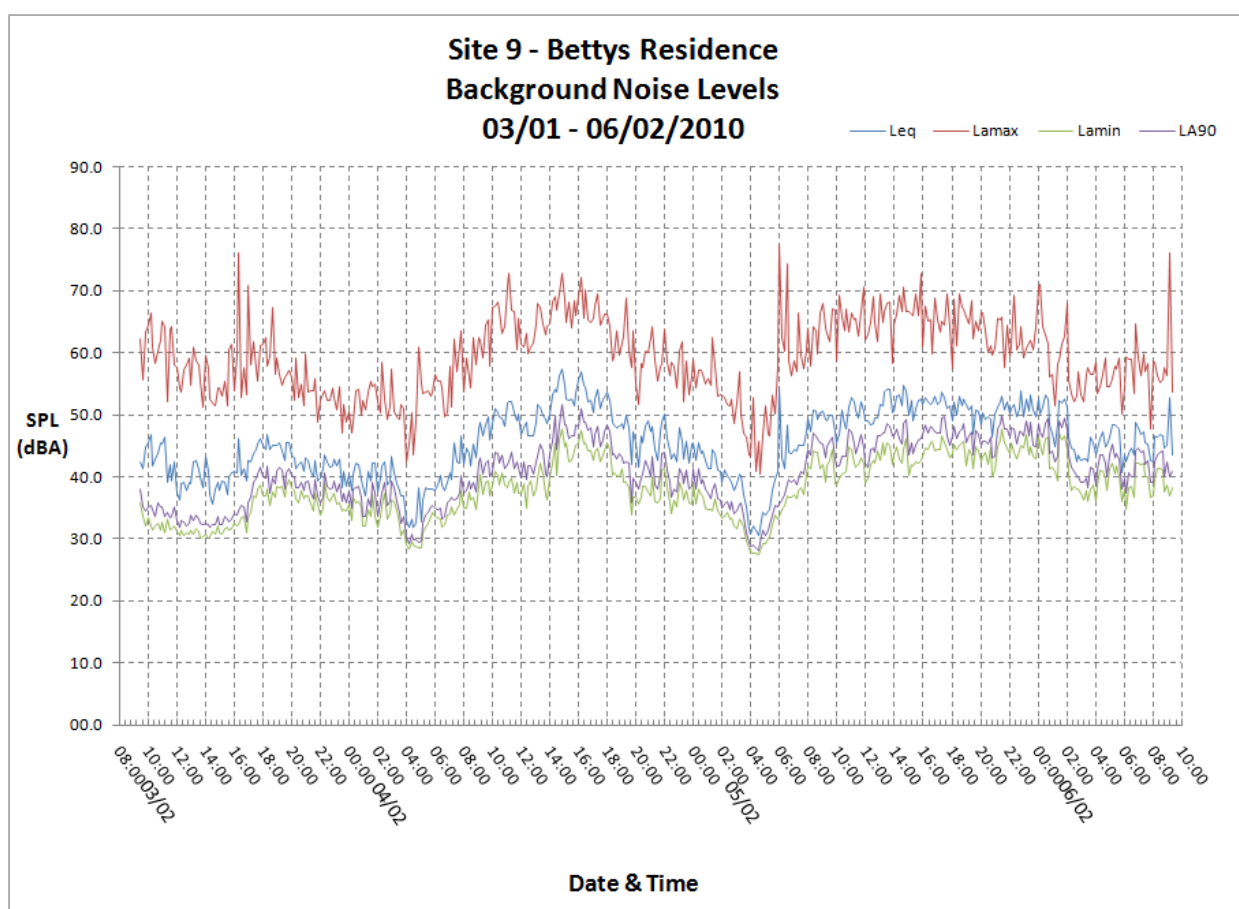
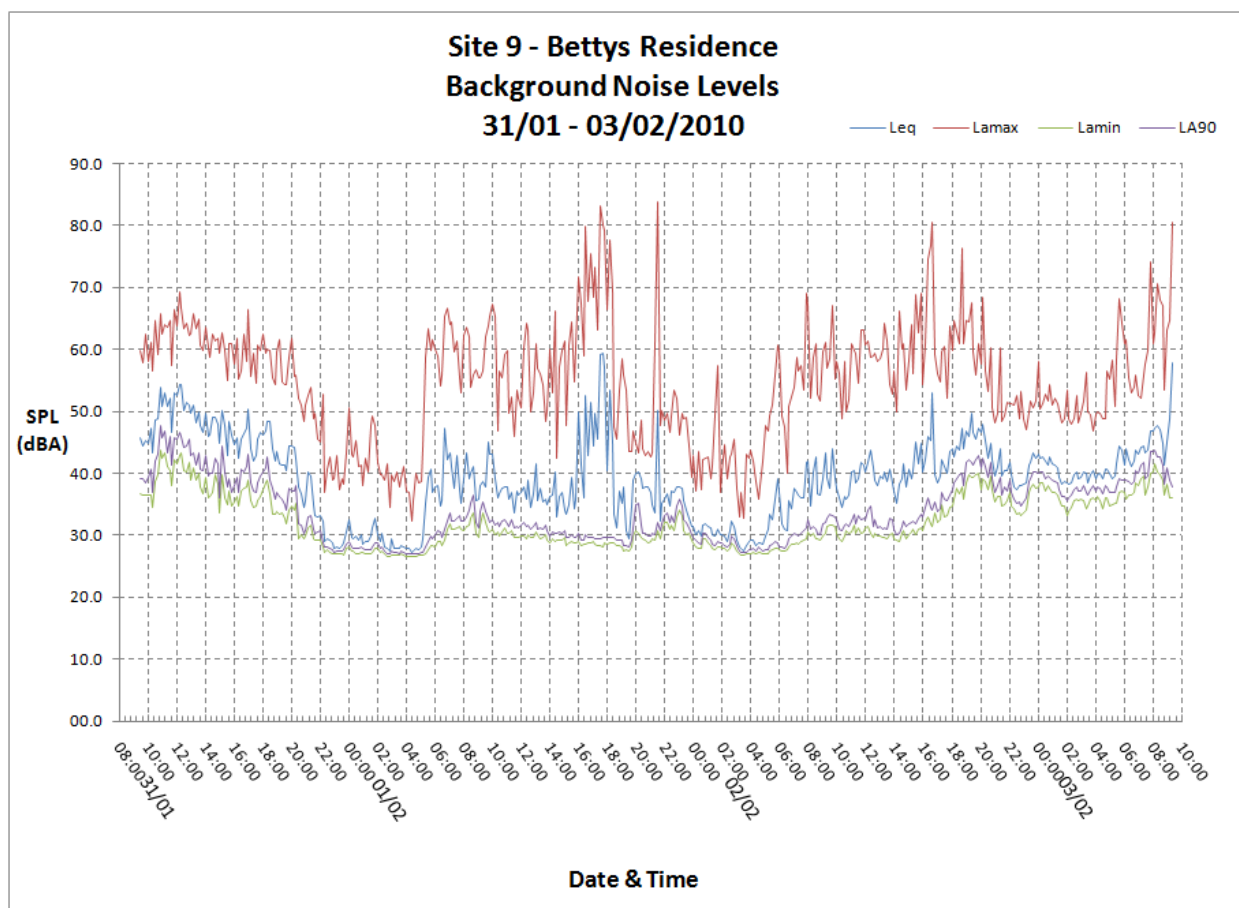


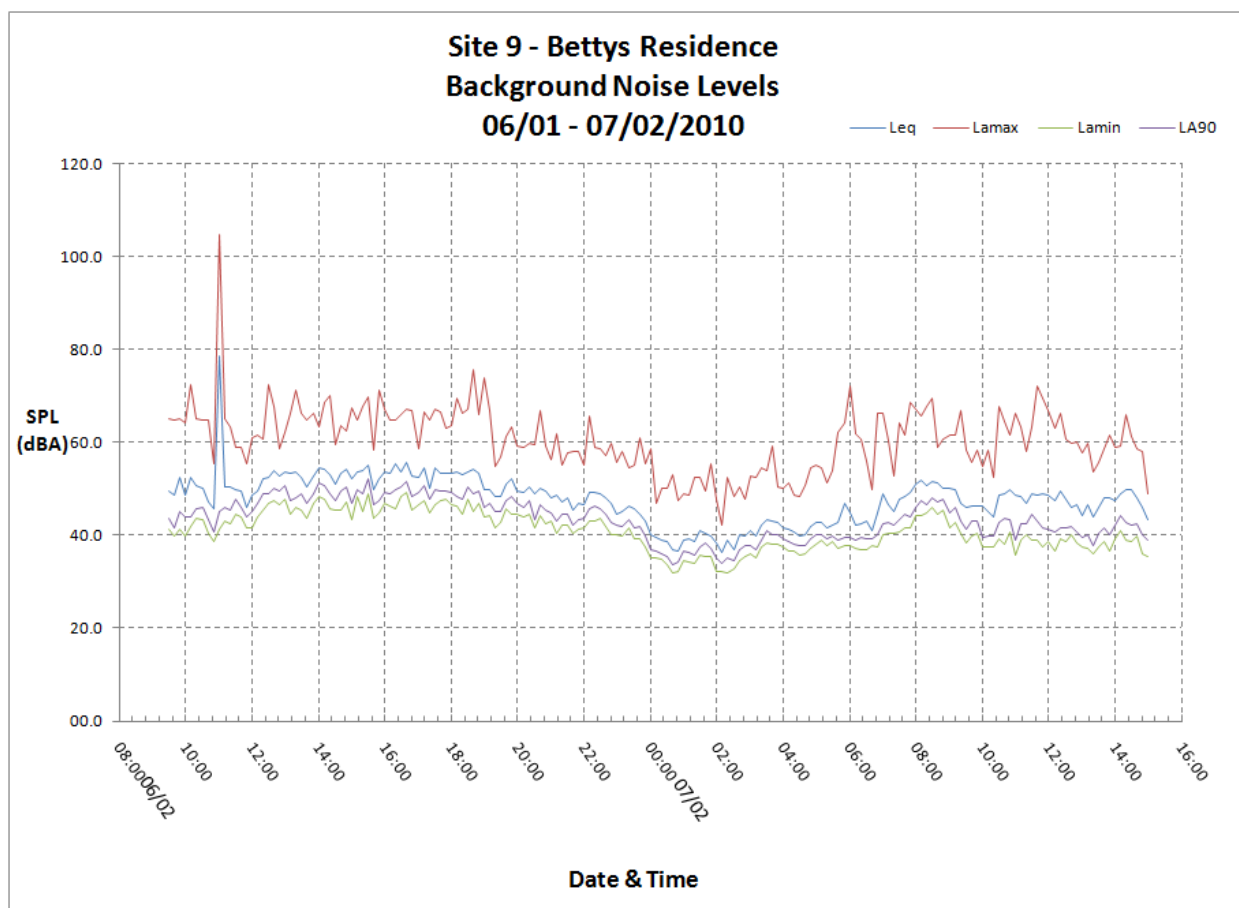


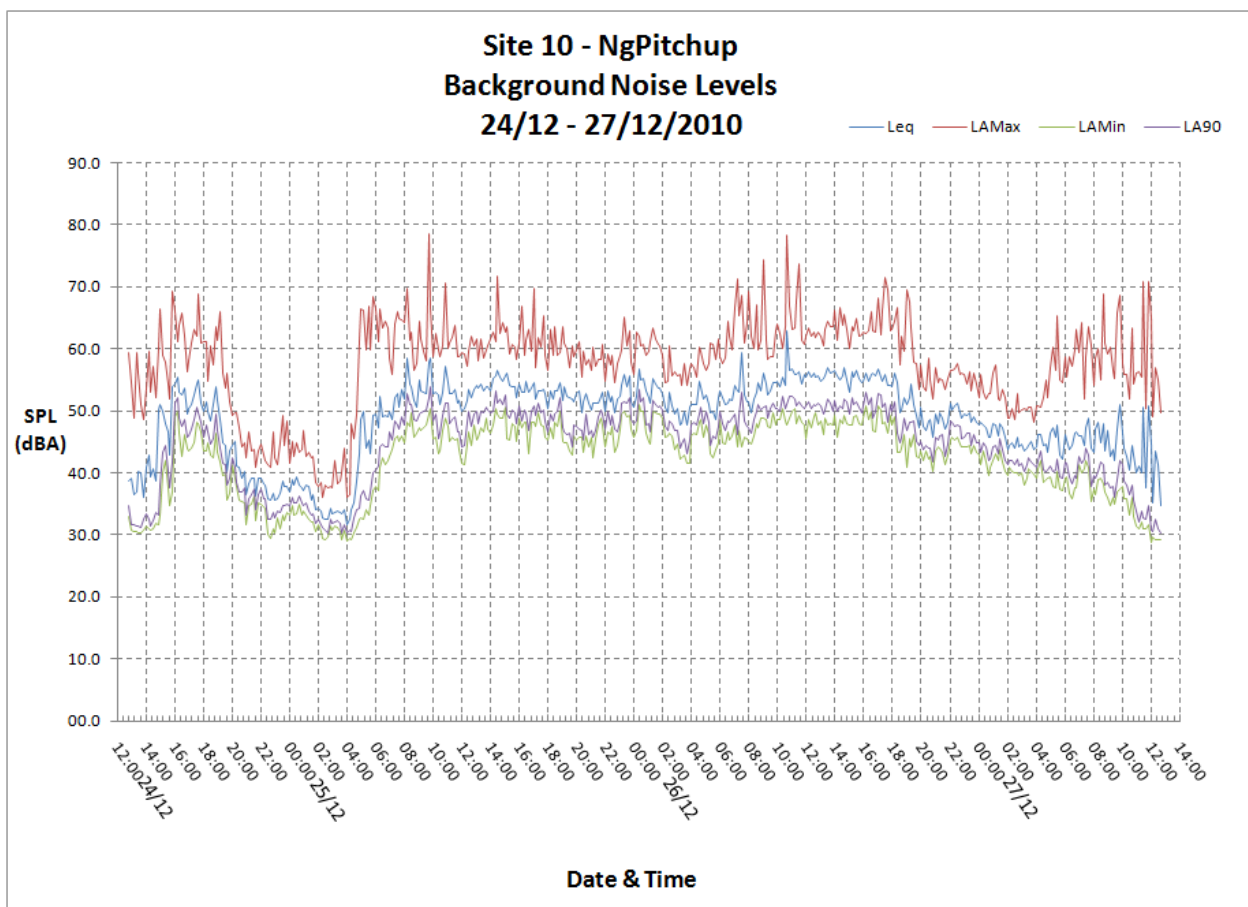
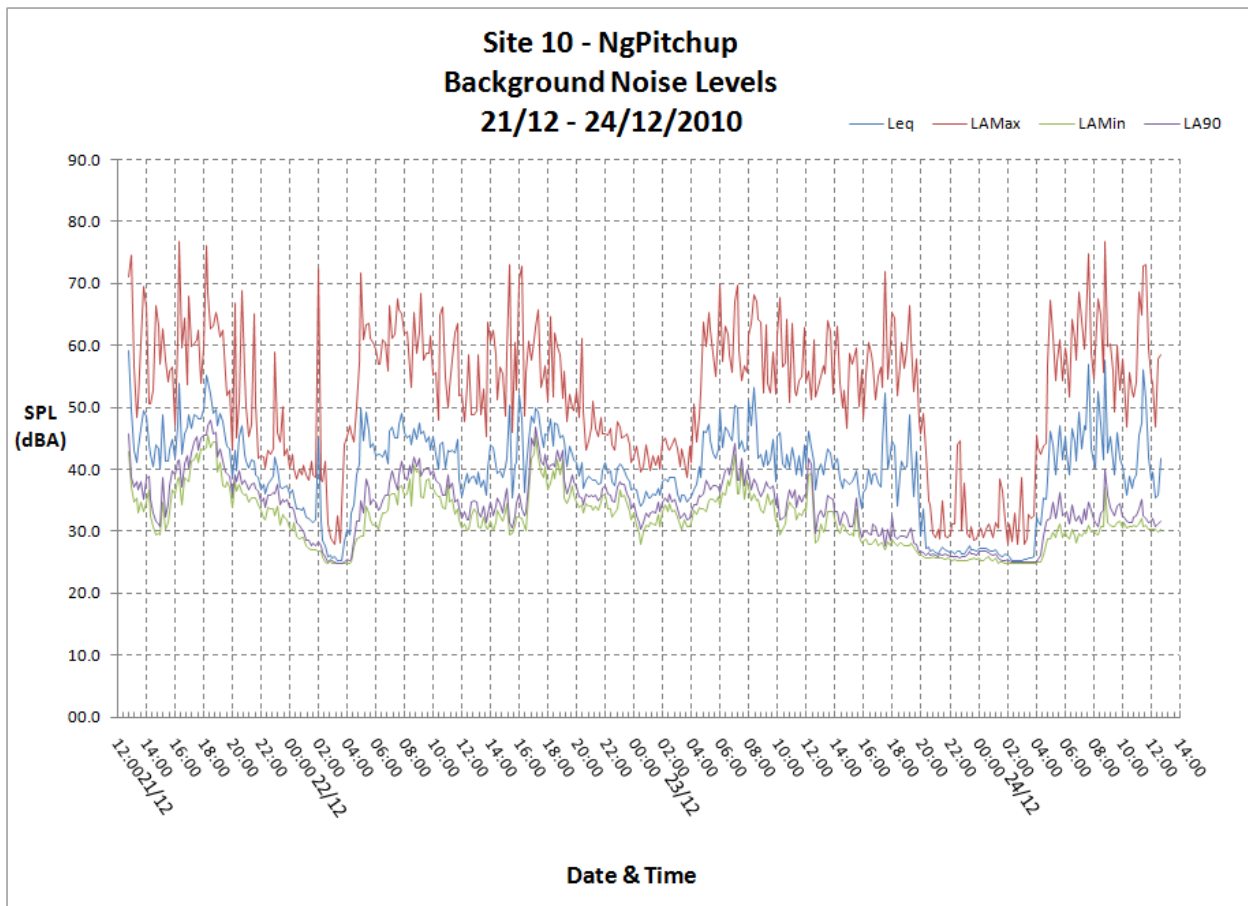


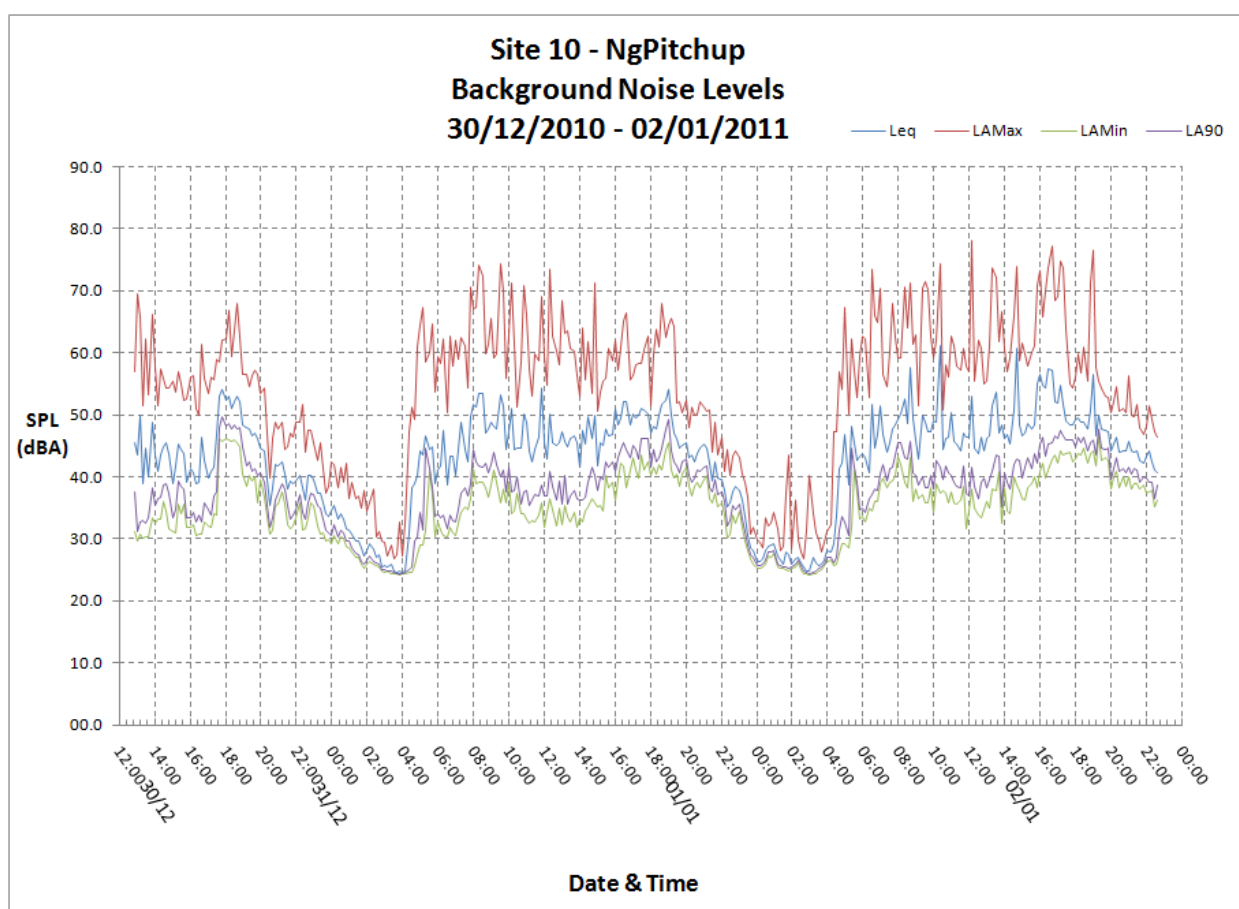
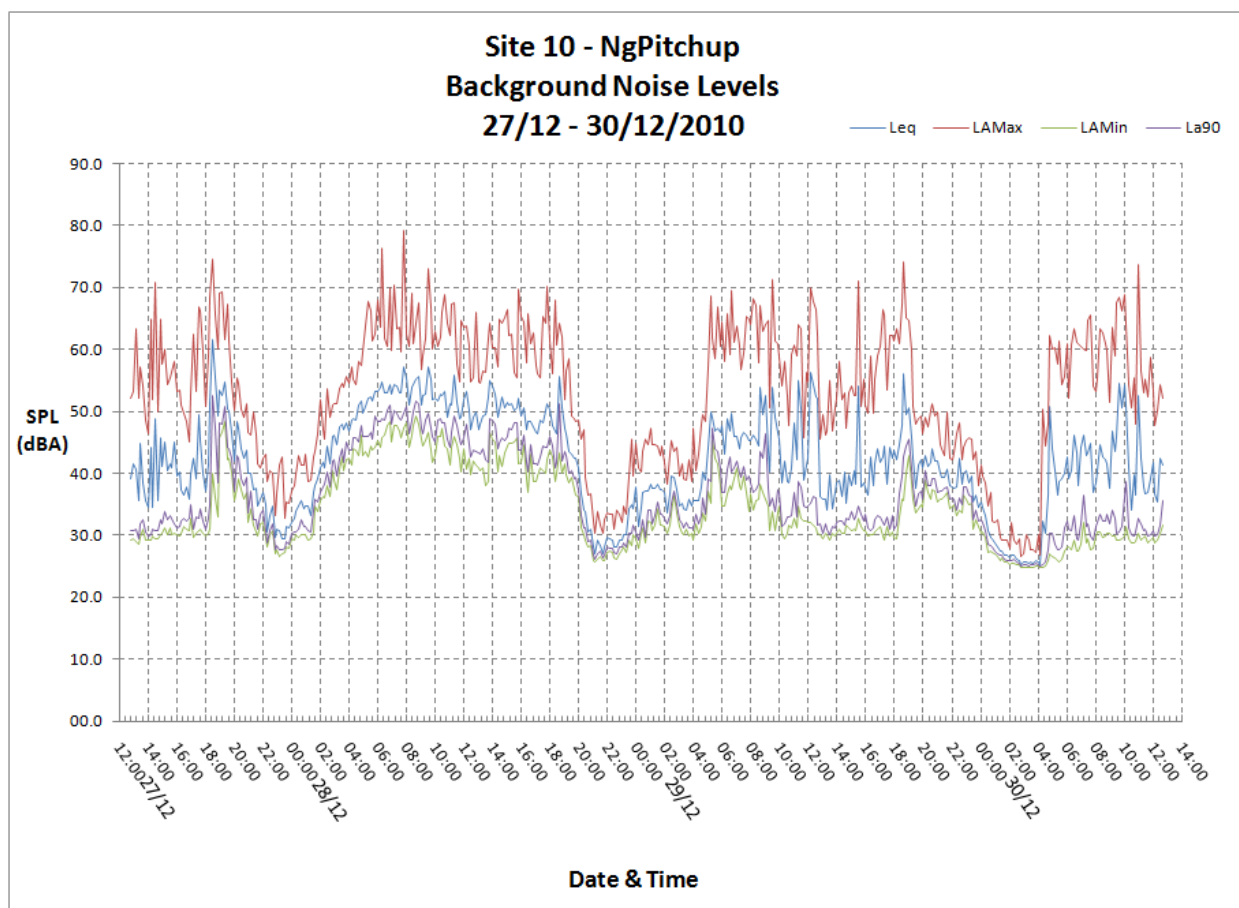


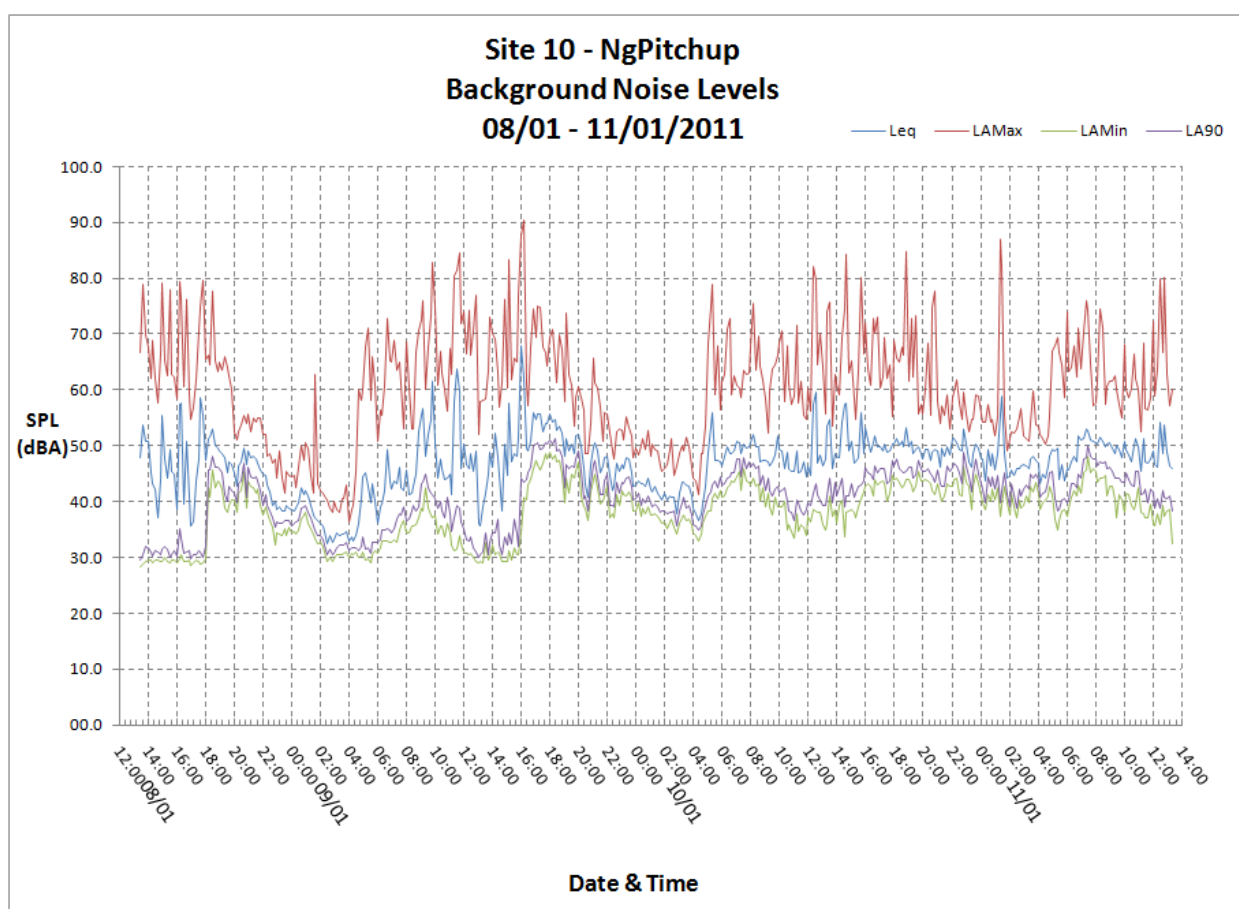
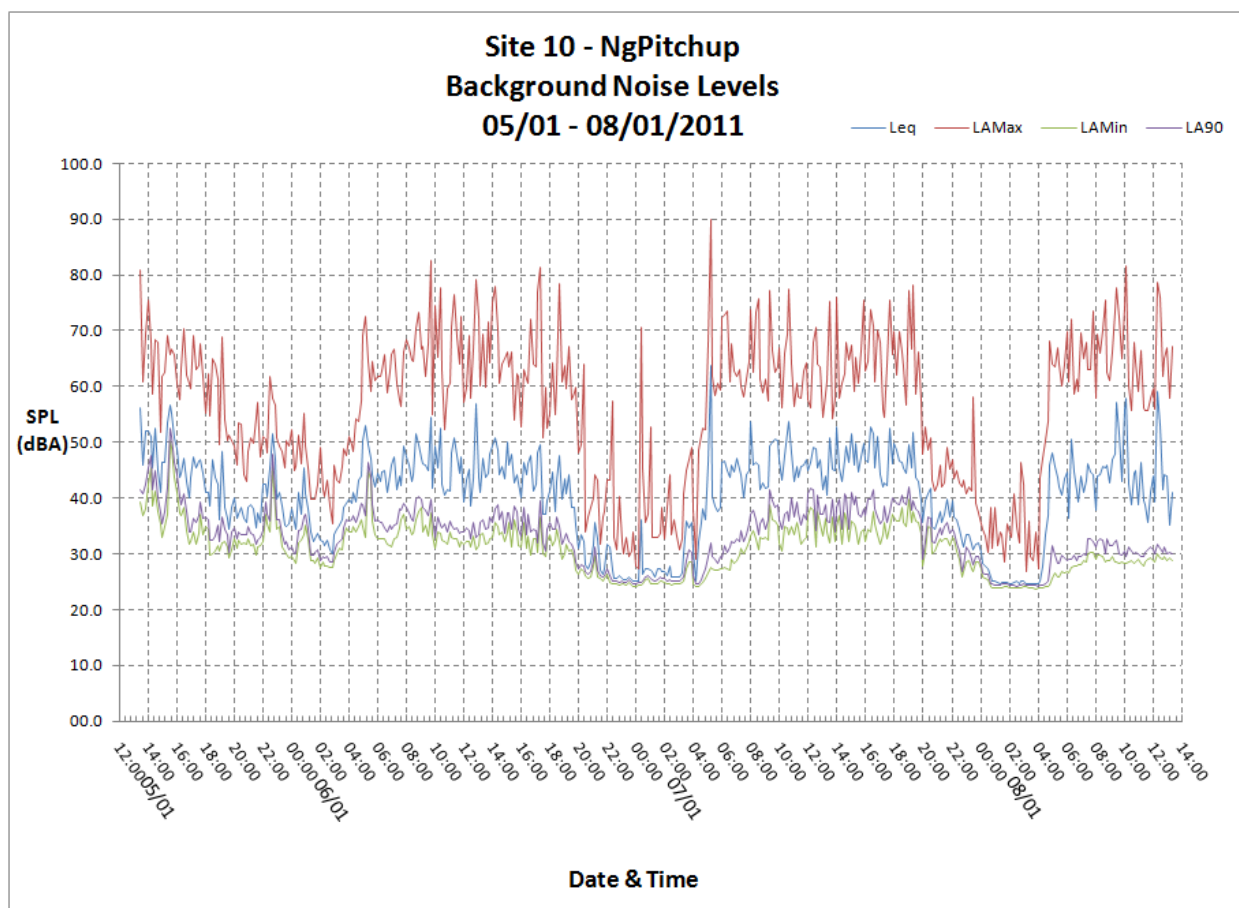


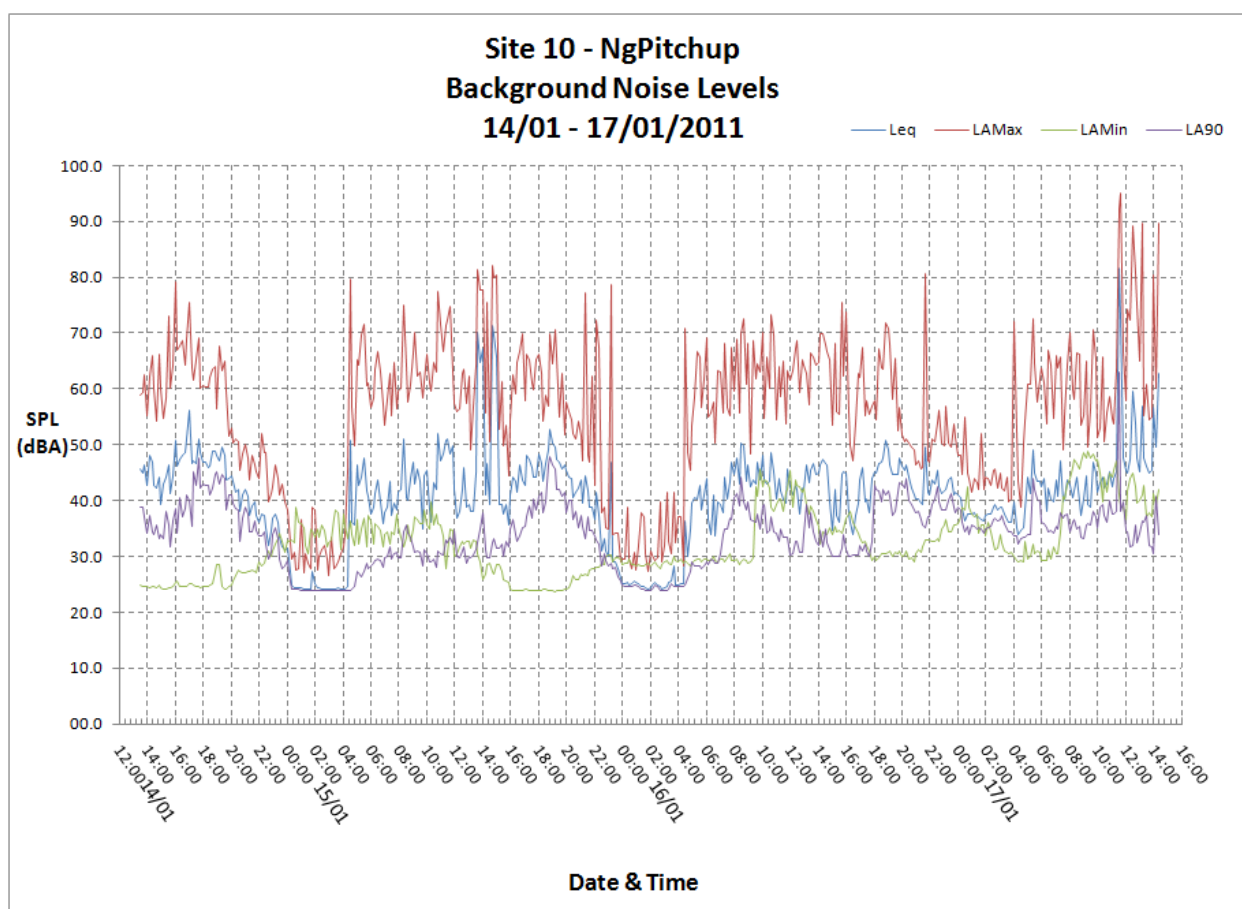
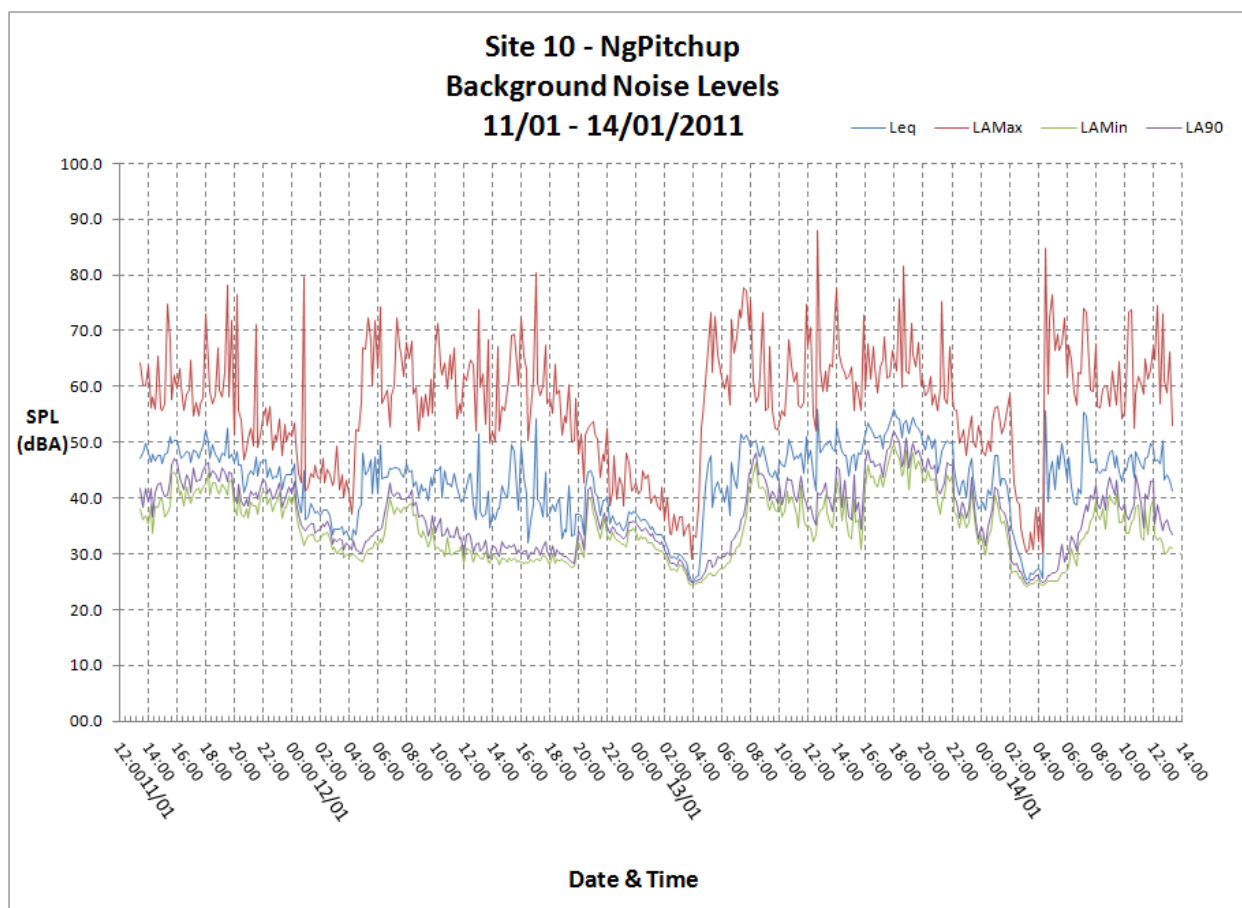


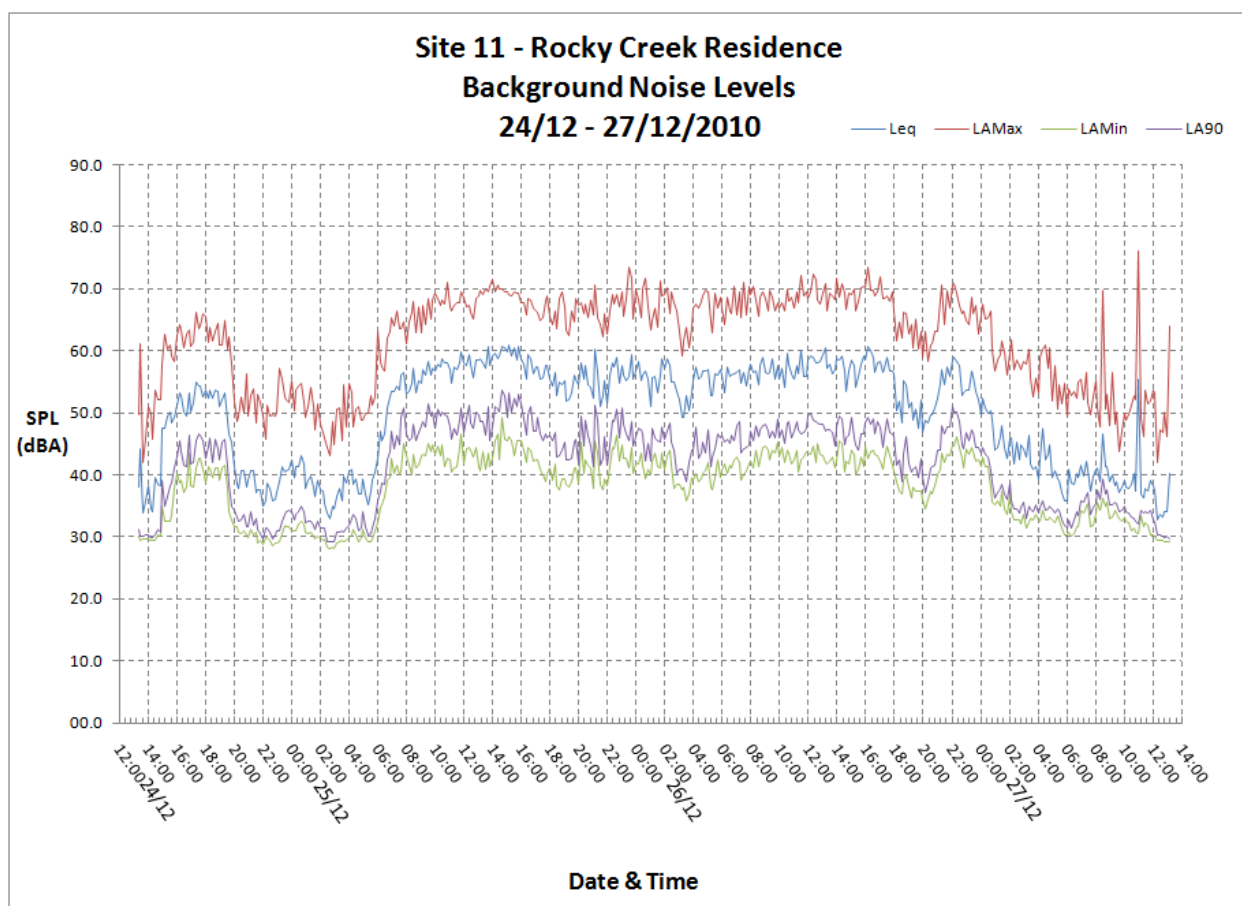
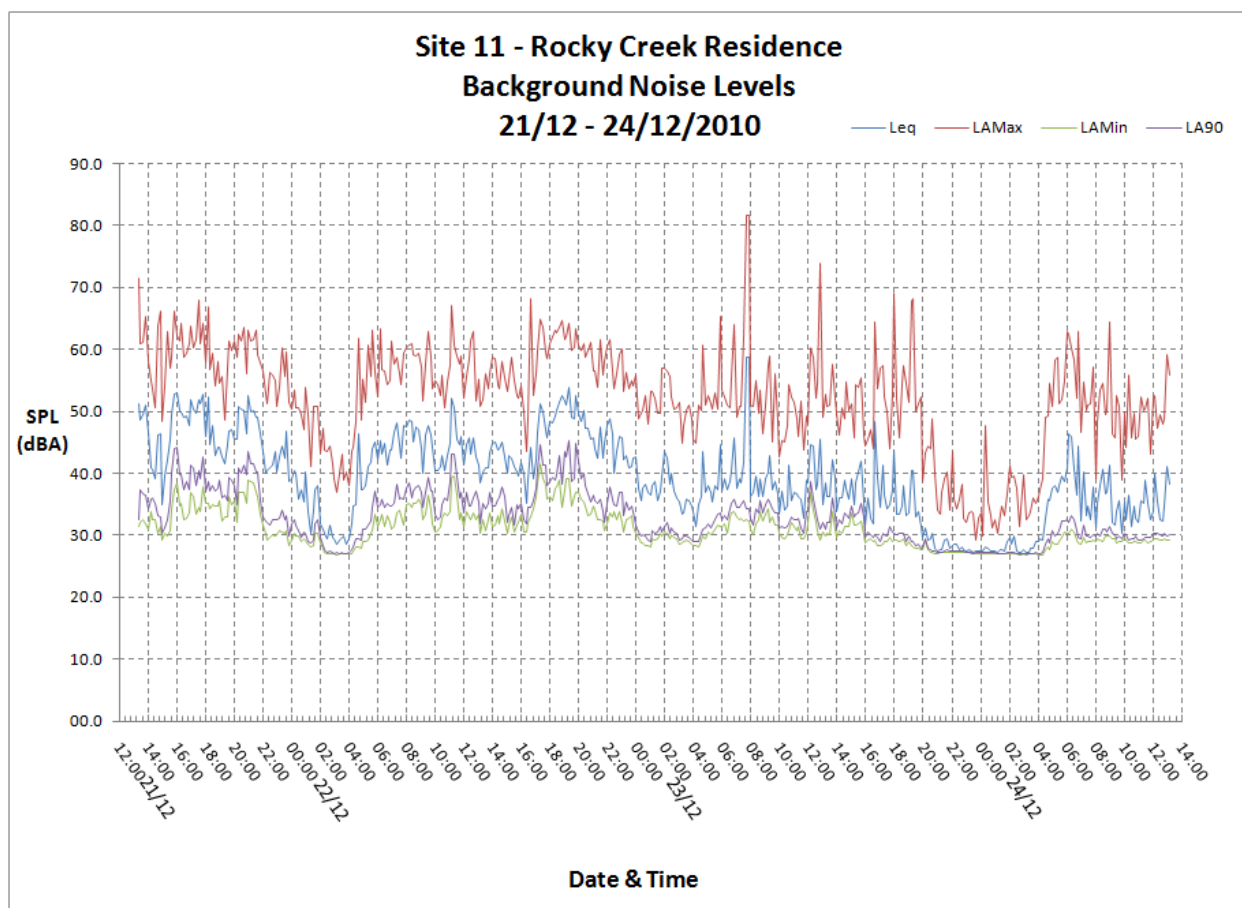


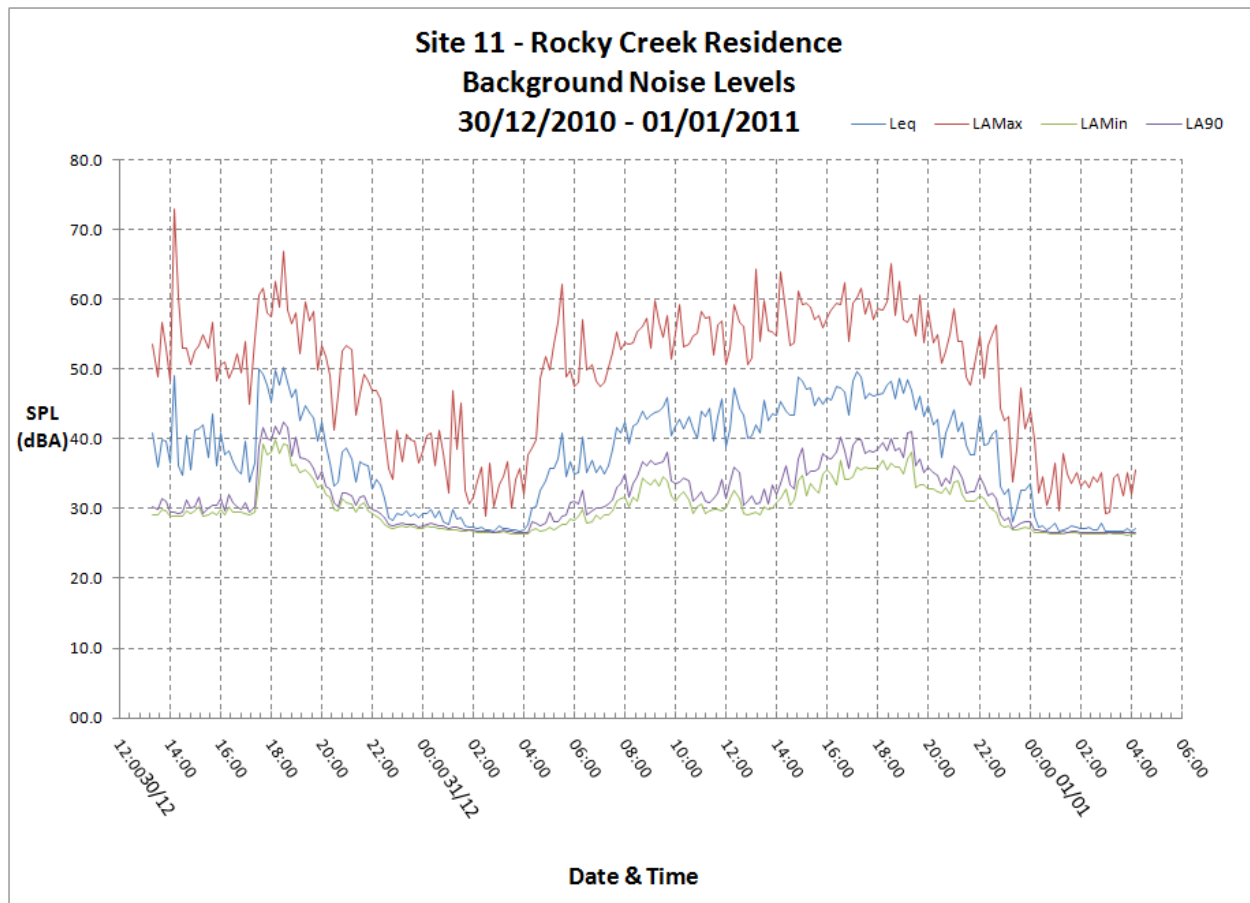
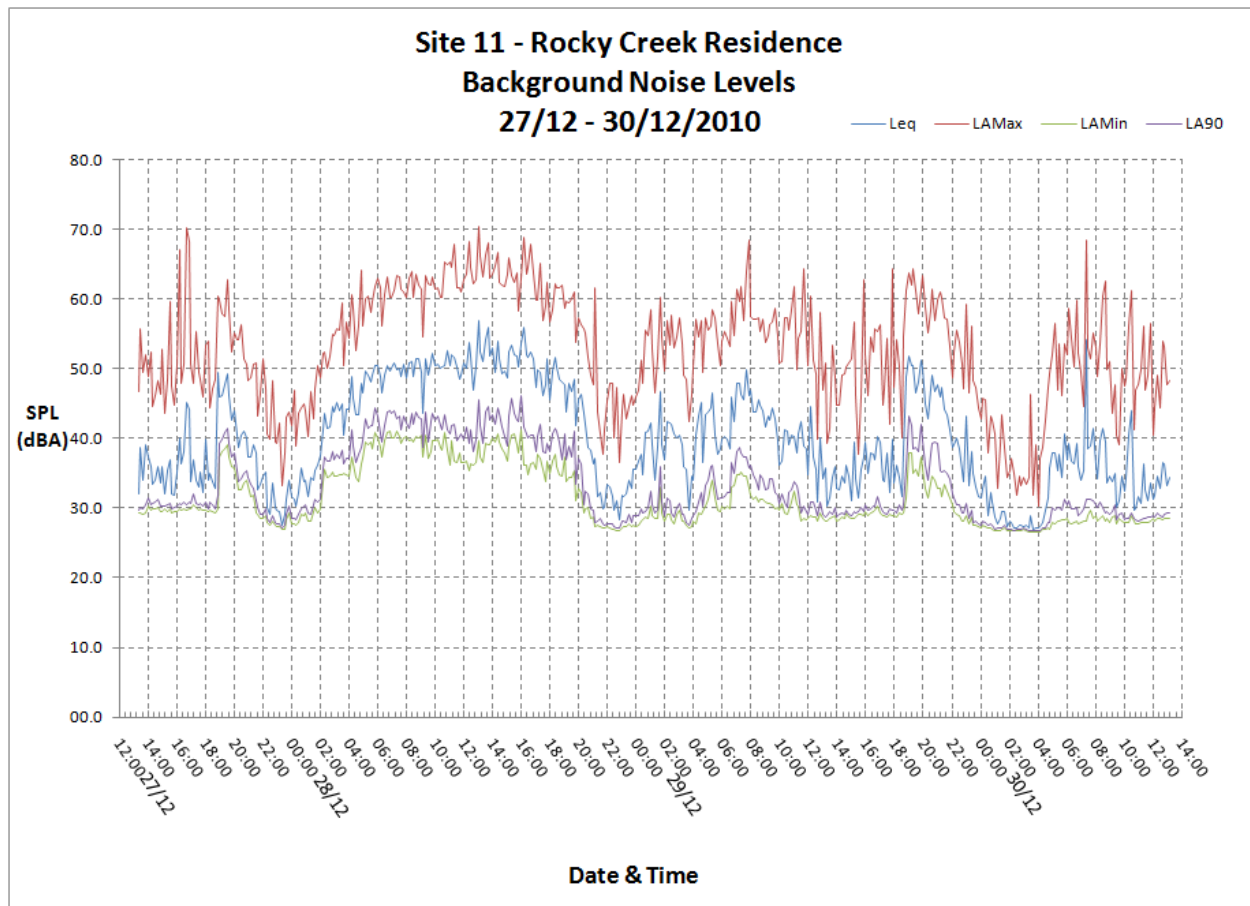


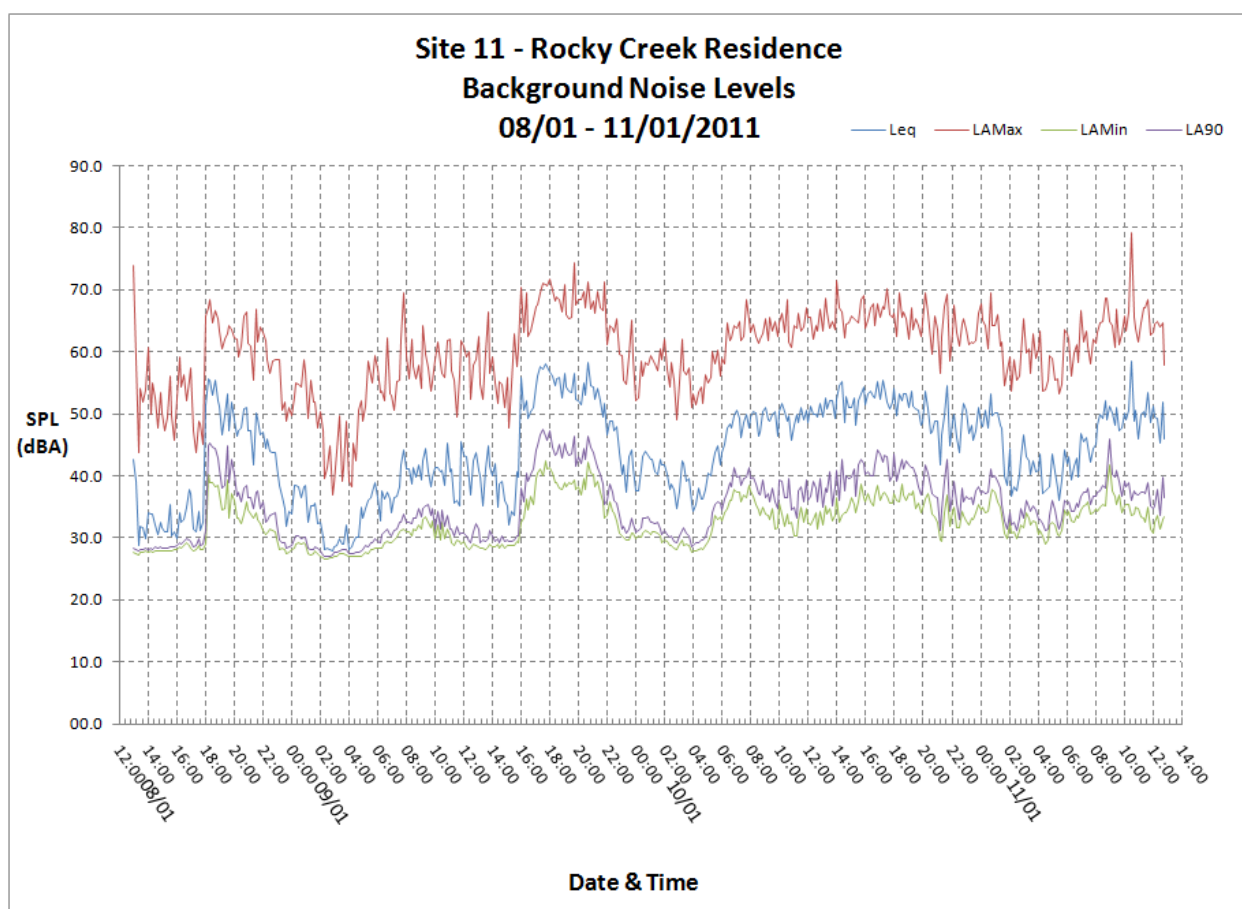
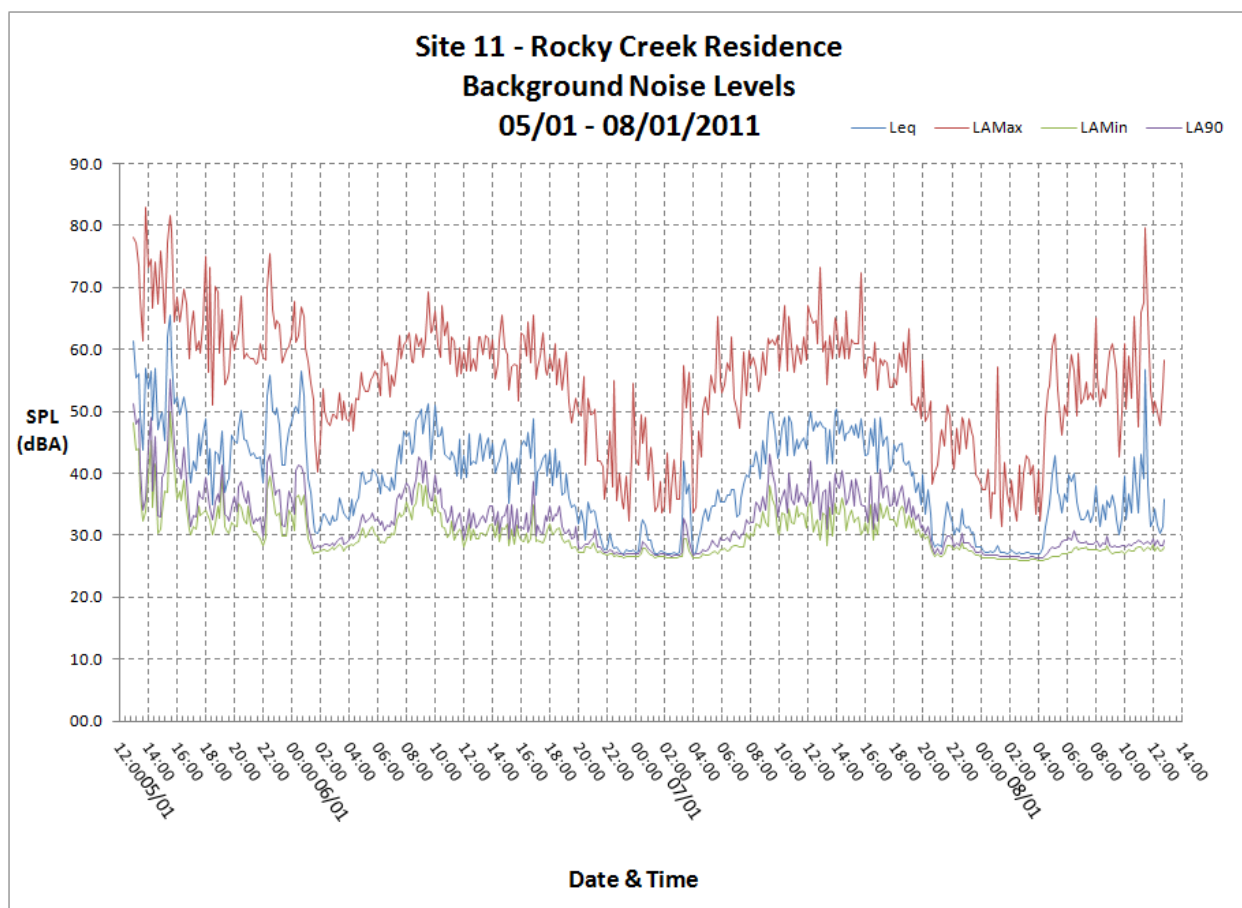


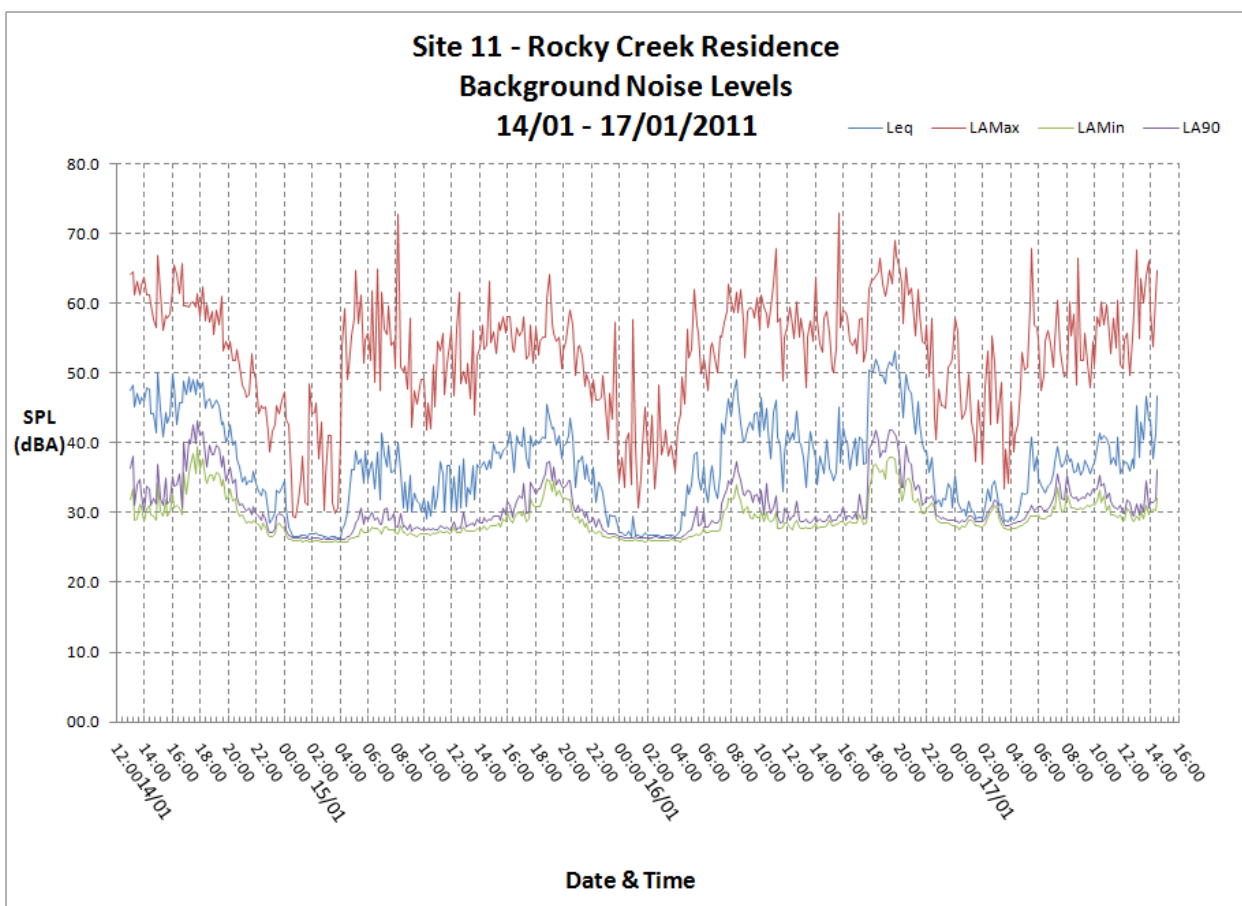
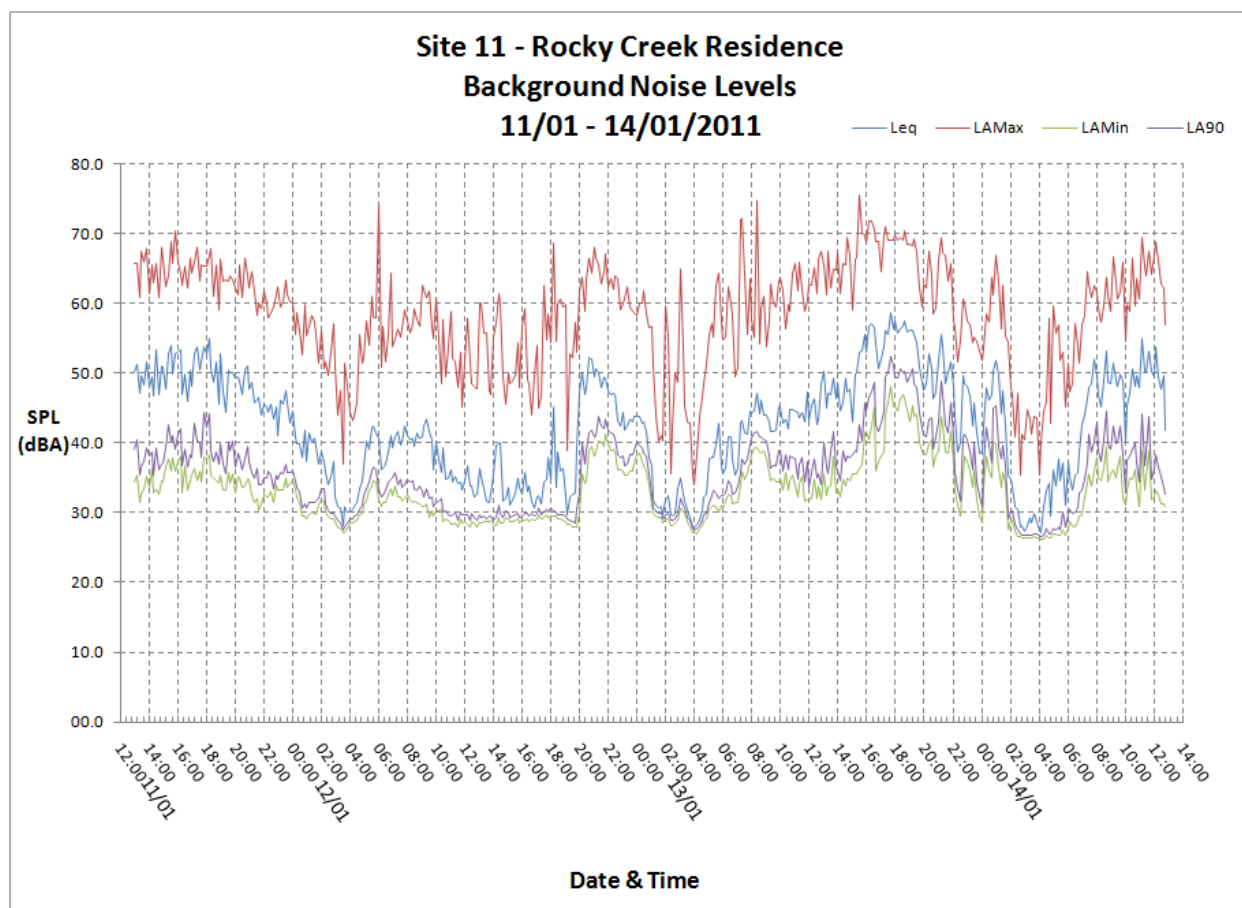












# **APPENDIX E**

## **CALIBRATION CERTIFICATES**