Forth Replacement Crossing

Employer's Delivery Team
Construction Noise Monitoring Report

FIFE ITS Contract
(May 2012)

TRANSPORT SCOTLAND

An agency of The Scottish Government

FORTH REPLACEMENT CROSSING

FORTH REPLACEMENT CROSSING

EMPLOYER'S DELIVERY TEAM
CONSTRUCTION NOISE MONITORING REPORT

FIFE ITS CONTRACT (MAY 2012)

Revision Status

Revision	Date	Description	Author	Approved for Use
0	August 2011	Original	DGC	AMM

FORTH REPLACEMENT CROSSING

EMPLOYER'S DELIVERY TEAM
CONSTRUCTION NOISE MONITORING REPORT

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1. INTRODUCTION

1.1 This report sets out the results of the construction noise monitoring undertaken on the Fife ITS Contract during May 2012 as part of the Forth Replacement Crossing project.

APPENDIX A - CONSTRUCTION NOISE MONITORING REPORT

GRAHAM CONSTRUCTION

FORTH REPLACEMENT CROSSING – FIFE ITS

FRC/FITS/JG/PCNV/CP/0014

NOISE COMPLIANCE MONITORING REPORT FOR MAY – Revision 1

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Date:	12/06/2012	**Date:**	15/06/2012

Comments:

nqa. ISO 14001 Registered — UKAS ENVIRONMENTAL MANAGEMENT 015

Revision Record

Revision	*Date*	*By*	*Summary of Changes*	*Checked*	*Approved*
Rev 1	13/08/12	RMcF	Changes following receipt of Compliance Report CR00421	RMcF	RMcF

Fife ITS Scheme

May Noise Compliance Report

June 2012

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Fife ITS Scheme

May Noise Compliance Report

Client Name: Graham Construction
Document Reference: EED12317-100-R-12.1.2-MM
Project Number: EED12317

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2008 and BS EN ISO 14001: 2004)

Issue	Date	Prepared by	Checked by	Approved by
First	June 2012	Jon Lee Consultant	Mark Maclagan Principal Consultant	Jo Bagley Associate Director
Second	August 2012			

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1. Introduction

Waterman Energy, Environment & Design Limited (hereafter 'Waterman') was instructed by John Graham (Dromore) Limited to undertake compliance noise monitoring during resurfacing and expansion joint works of the south bound carriageway of the M90. Noise monitoring was completed in line with the guidance provided in the Forth Replacement Crossing Code of Construction Practice (the CoCP) and Appendix 1/9 of the Employers Requirements (hereafter 'the Employers Requirements').

A Plan for the Control of Noise and Vibration was submitted and approved for the works to be undertaken during the resurfacing works (FRC-FITS-JG-PCNV0010) which assessed the potential noise impacts associated with the resurfacing works and expansion joint works on Masterson Viaduct.

In order to ensure compliance with Best Practicable Means (BPM) the approved PCNV, CoCP and the Employers Requirements noise monitoring was undertaken at four locations representative of the closest sensitive receptors to the works. This document sets out the findings of the compliance monitoring exercise.

2. Site Description and Development Proposals

2.1 Works Description

The works undertaken included the resurfacing of the southbound carriageway of the M90 between Chainage 9090 and Chainage 13050. The sequence of works for the resurfacing process is set out below:

- Set up of traffic management schemes on the southbound carriageway;
- Plane off existing surfaces on the southbound carriageway; and
- Total closure of the southbound carriageway of the M90, 3 surface paving machines lay surfacing in tandem over three lanes. Surfacing took place over three consecutive weekend closures of the M90 southbound.

The main re-surfacing works were completed in April 2012, however some small scale resurfacing works and expansion joint works continued in the vicinity of Craig Street and Park Lea throughout the month of May.

2.2 Noise Sensitive Receptors

The closest noise sensitive receptors to the resurfacing works were identified following a site walkover. The noise sensitive receptors are described in Table 1.

Table 1 Noise Sensitive Receptors

Noise Sensitive Receptor	Name	Description	Approximate Grid Reference	Distance from Works
NSR A	Craig Street	Two story residential dwellings	312355,683622	60m
NSR B	Park Lea	Two story residential dwellings	312410,683958	60m

3. Noise Assessment Criteria

Section A2 of Appendix 1/9 of the Employers Requirements and The Forth Replacement Crossing Code of Construction Practice (CoCP) require that noise levels generated during the construction of any phase of works should not exceed the residual effects set out in the Forth Replacement Crossing Environmental Statement ("the ES"). This document sets out the ABC Threshold Level assessment methodology presented in Appendix E of BS5228-1:2009 as being the appropriate assessment methodology for the works.

This method defines category threshold values which are determined by the time of day and existing monitored ambient noise levels. The noise level generated by construction activities is then compared with the 'threshold value'. If the total noise level exceeds the 'threshold value', a significant effect is deemed to occur. The construction noise impact criteria are set out in Table 2.

Table 2 Construction Noise Impact Criteria

Period	Assessment Category					
	A		B		C	
	$L_{Aeq,T}$	L_{Amax}	$L_{Aeq,T}$	L_{Amax}	$L_{Aeq,T}$	L_{Amax}
Night	45	60	50	65	55	65
Evening	55	70	60	75	65	80
Day	65	80	70	85	75	90
Saturday	65	80	70	85	75	90

Note:

- Category A: are threshold values to use when ambient levels rounded to the nearest 5dB) are less than these values;
- Category B: are values to use when ambient noise levels (rounded to the nearest 5dB) are the same as the Category A values; and
- Category C: are values to use when ambient noise levels (rounded to the nearest 5dB) are greater than Category A values.

Consideration is also required to $L_{Amax,fast}$ noise levels in line with Section 5.4 of the CoCP. The Employers Requirements require the execution of the works to be limited to maximum noise levels that are 5dB lower than those defined in the CoCP and summarised in Table 2.

A baseline noise monitoring exercise was undertaken at locations representative of the closest sensitive receptors to the Fife ITS study corridor. The monitoring data is provided in full as report FRC-FTIS-JG-NVMP-BMR-0001. Following completion of the baseline monitoring exercise noise assessment category levels were set in line with the guidance provided within the CoCP and the Employers Requirements (see Table 2). The assessment category levels in terms of $L_{Aeq,T}$ and L_{Amax} are presented as Table 3.

Table 3: Summary of Noise Threshold Levels

Monitoring Location	Period	L_{Aeq} Assessment Category Level	L_{Amax} Threshold level
NSR A -Craig Street	Daytime	70	85
	Evening	65	80
	Night-time	55	65
NSR B - Park Lea	Daytime	75	90
	Evening	65	80
	Night-time	55	65

4. Noise Monitoring Methodology

Noise monitoring was undertaken at selected locations throughout resurfacing works on the southbound carriageway of the M90. Monitoring locations were selected so as to be representative of the closest sensitive receptors to the works. The monitoring locations are described in full in Table 4.

Table 4: Noise Monitoring Locations

Location	Description	Notes
ML1	**Craig Street**	Noise climate dominated by road traffic on the M90. Some noise associated with local traffic was also noted.
ML2	**Park Lea**	Noise climate dominated by road traffic on the M90. Some noise associated with local traffic was also noted.

Noise monitoring was undertaken by Jon Lee who holds corporate membership to the Institute of Acoustics and is fully competent and trained in the use of the noise monitoring equipment.

The parameters logged throughout the survey period were L_{Aeq}, L_{Amax}, L_{Amin}, L_{A90} and L_{A10}. These parameters are described in Appendix A. The L_{Aeq} level is the equivalent continuous sound pressure level over the measurement period; L_{Amax} is an indicator of the highest sound level during the measurement period; the L_{Amin} is the lowest level during the measurement period; L_{A90} is used as a descriptor of background noise levels and L_{A10} is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.

The monitoring equipment used during the survey period is described in Table 5. The sound level meter was calibrated both before and after each monitoring period; no significant drift from the reference level of 94 dB was recorded. The monitoring equipment used during the survey period is described in Table 5. The sound level meter was calibrated both before and after each monitoring period; no significant drift from the reference level of 94dB was recorded.

All measurements were unattended and undertaken under free-field conditions. However, during night-time works a member of Waterman's Noise and Vibration Team was on site at all times A wind shield was fitted to the monitoring equipment at all times. Weather conditions experienced throughout the survey period are set out as Appendix B.

Table 5: Noise Monitoring Equipment

Sound Level Meter	ML1	ML2
Meter Model	Rion NL-32	Rion NL-31
Serial Number	00482656	00562436
Calibrator		
Calibrator Model	Rion NC-74	Rion NC-74
Serial Number	35173533	35173533
Calibration Level at 1000 Hz	94dB	94dB
Microphone		
Microphone Type	UC-53A	UC-53A

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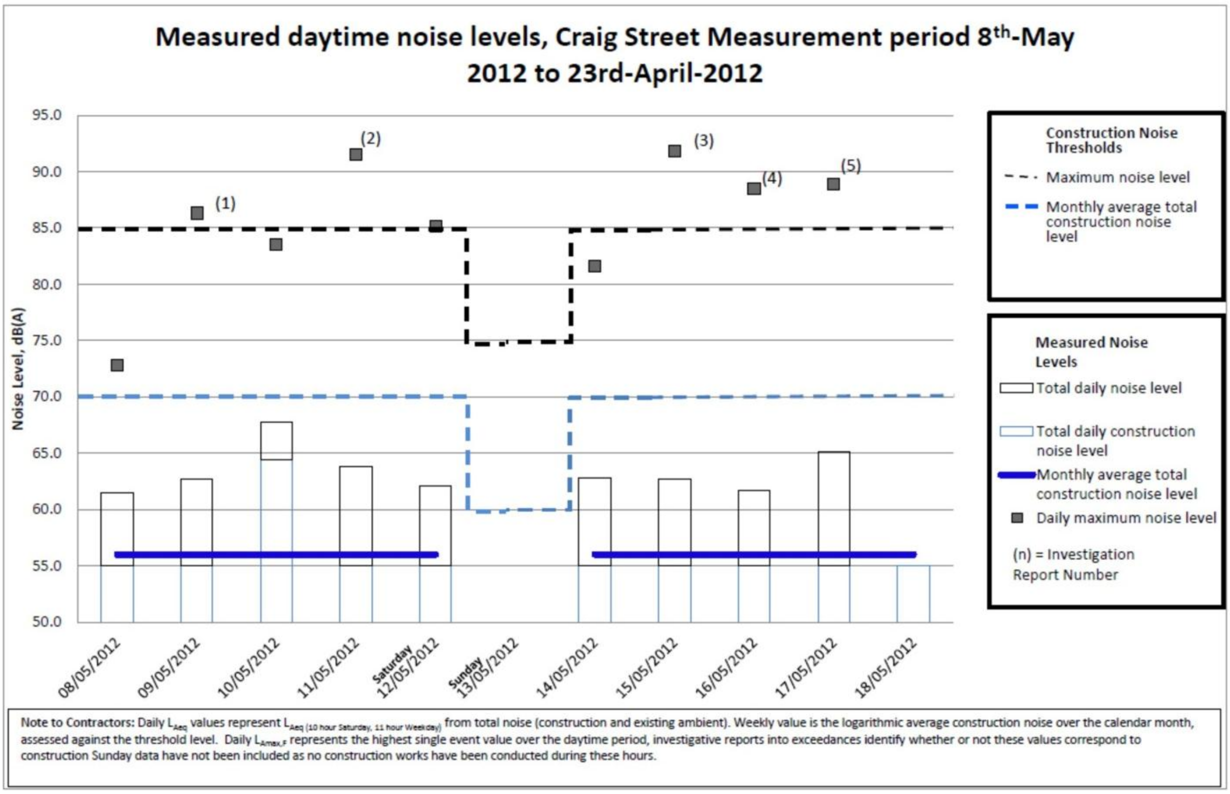
5. Noise and Monitoring Results

5.1 ML1 Craig Street

Noise monitoring at Craig Street commenced on the 8th May 2012 and continued through until 18th May 2012. The monitoring results are presented in the NLG approved format as Graph 1. Works were undertaken during the daytime period only during this survey period.

Graph 1 – Monitored Noise Levels Craig Street



Monitored noise levels presented as Graph 1 indicate that both the weekly average total construction noise levels and monthly average construction noise levels fell significantly below the category threshold level throughout the survey period.

Monitored noise levels in terms of L_{Amax} were noted to be in excess of the adopted assessment criteria for the majority of the survey period. However, further investigation has indicated that the monitored noise levels in terms of L_{Amax} occurred as a result HGVs travelling at speed along the M90 and localised activity within the garden of the property and not as a direct result of surfacing works. Exceedance reports for the survey period are provided as Table 6 .

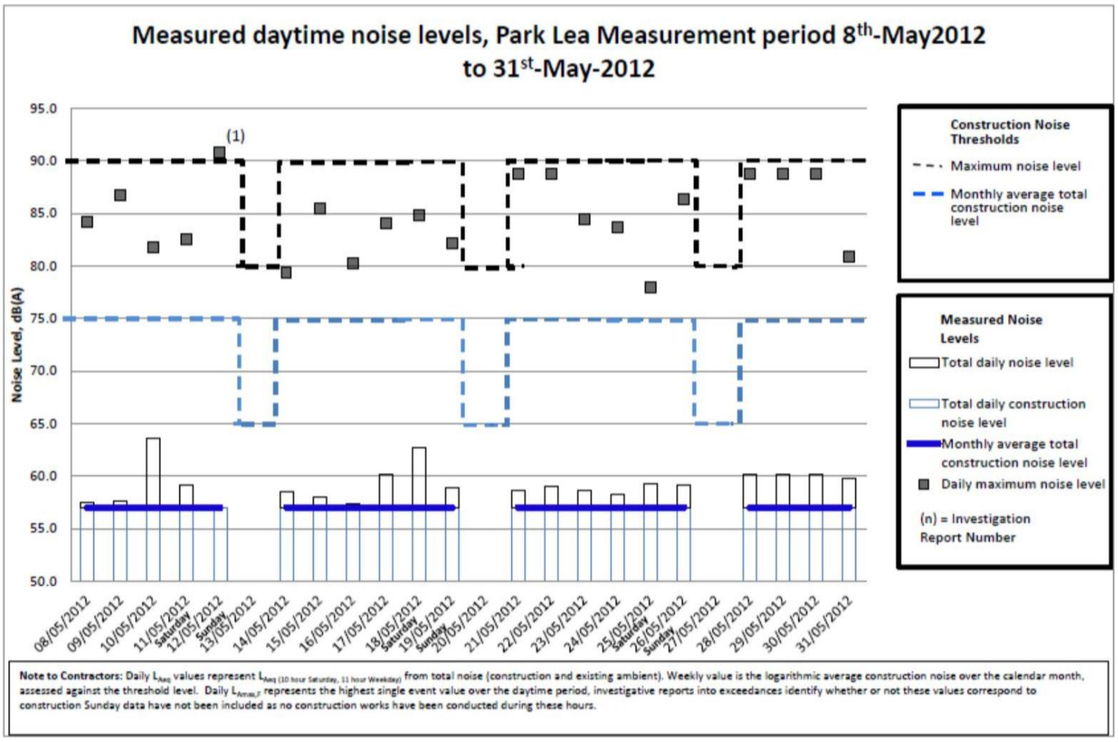
Table 6: LAmax Exceedance Reports (Refer to Graph 1)

Report Number	Description
1	A small exceedance of the 85dB L_{Amax} daytime criteria was recorded on the 9th May 2012. The sound level meter was located in the rear garden of a residential property on Craig Street within direct line of site of vehicles travelling along the M90. Further investigation of the monitoring data indicated the exceedance on this occasion arose as a result of a single HGV pass-by along the M90.
2	An exceedance of the 85dB L_{Amax} daytime criteria was recorded on the 11th May 2012. The sound level meter was located in the rear garden of a residential property on Craig Street within direct line of site of vehicles travelling along the M90. Further investigation of the monitoring data during this period and a review of audio recording indicated the exceedance on this occasion arose as a result of what appeared to be localised DIY works.
3	An exceedance of the 85dB L_{Amax} daytime criteria was recorded on the 15th May 2012. The sound level meter was located in the rear garden of a residential property on Craig Street within direct line of site of vehicles travelling along the M90. Further investigation of the monitoring data indicated the exceedance on this occasion arose as a result of a single HGV pass-by along the M90.
4	An exceedance of the 85dB L_{Amax} daytime criteria was recorded on the 16th May 2012. The sound level meter was located in the rear garden of a residential property on Craig Street within direct line of site of vehicles travelling along the M90. Further investigation of the monitoring data indicated the exceedance on this occasion arose as a result of a single HGV pass-by along the M90.
5	An exceedance of the 85dB L_{Amax} daytime criteria was recorded on the 17th May 2012. The sound level meter was located in the rear garden of a residential property on Craig Street within direct line of site of vehicles travelling along the M90. Further investigation of the monitoring data indicated the exceedance on this occasion arose as a result of a single HGV pass-by along the M90.

5.2 ML2 Park Lea

Noise monitoring at Park Lea commenced on the 8th May 2012 and continued until the 31st May 2012. The monitoring results are presented as Graph 2.

Graph 2 – Monitored Noise Levels Park lea



Monitored noise levels presented as Graph 2 indicate that both the weekly average total construction noise levels and monthly average construction noise levels fell significantly below the category threshold level throughout the survey period.

Monitored noise levels in terms of L_{Amax} were also noted to fall below the threshold level with the exception of on the 11th May 2012 were a single exceedence of the L_{Amax} criteria was recorded. Further investigation has indicated that the monitored noise levels in terms of L_{Amax} occurred as a result of HGVs travelling at speed along the M90 and not as a direct result of surfacing works.

Appendix A Acoustic Terminology

Ambient sound
The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.

Assessment period
The period in a day over which assessments are made.

A-weighting
A frequency weighting applied to measured or predicted sounds levels in order to compensate for the non-linearity of human hearing.

Background noise
Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).

Broadband
Containing the full range of frequencies.

Decibel [dB]
The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound that is heard.

The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping.

Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day sounds;

Four engine jet aircraft at 100m	120 dB
Riveting of steel plate at 10m	105 dB
Pneumatic drill at 10m	90 dB
Circular wood saw at 10m	80 dB
Heavy road traffic at 10m	5 dB
Telephone bell at 10m	65 dB
Male speech, average at 10m	50 dB
Whisper at 10m	25 dB
Threshold of hearing, 1000 Hz	0 dB

dB(A):

A-weighted decibels
The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the 'A' filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.

Do-Minimum
Describes a scenario under which the road scheme that is under consideration does not proceed.

Façade Noise Level
A noise level measured or predicted at the façade of a building, typically at a distance of 1m, containing a contribution made up of reflections from the façade itself (+3dB).

L_{Amax} noise level
This is the maximum noise level recorded over the measurement period.

L_{Amin} noise level
This is the lowest level during the measurement period.

$L_{Aeq,T}$ noise level	This is the 'equivalent continuous A-weighted sound pressure level, in decibels' and is defined in British Standard 7445 as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time'. It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise.
L_{A90} noise level	This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.
L_{A10} noise level	This is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise
R_w	Single number rating used to describe the **laboratory** airborne sound insulation properties of a material or building element over a range of frequencies, typically 100-3150Hz.

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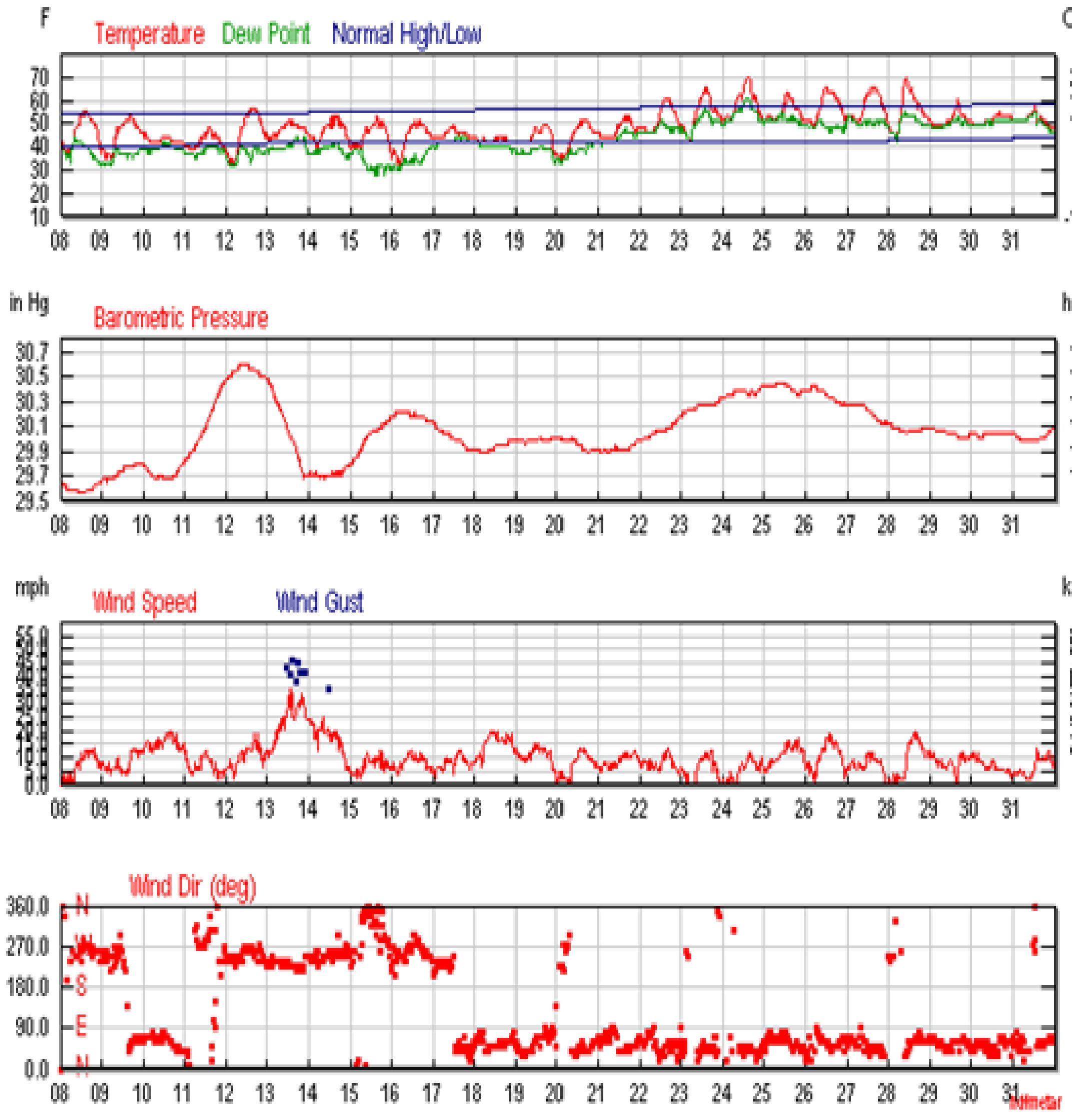
Appendix B Historical Weather Data

Observations

2012	Temp. (°C)			Dew Point (°C)			Humidity (%)			Sea Level Press. (hPa)			Visibility (km)			Wind (km/h)			Precip. (mm)	Events
May	high	avg	low	high	avg	low	high	avg	low	high	avg	low	high	avg	low	high	avg	high	sum	
8	13	7	2	7	4	0	100	76	54	1004	1002	1001	10	10	1	23	8	-	0.00	Fog
9	12	7	2	4	3	0	93	71	54	1009	1007	1004	10	10	10	23	11	-	0.00	
10	8	7	5	6	4	3	93	88	76	1010	1006	1005	10	9	5	32	24	45	0.00	Rain
11	9	7	4	5	4	2	93	85	76	1032	1020	1010	10	10	9	21	13	-	0.00	Rain
12	14	7	1	5	3	0	93	71	44	1036	1034	1032	10	10	10	29	14	-	0.00	
13	11	8	6	7	5	3	87	77	66	1032	1018	1005	10	10	6	58	32	80	0.00	Rain
14	12	8	5	6	4	2	87	73	62	1009	1006	1005	10	10	9	40	31	58	0.00	Rain
15	12	7	2	4	1	-2	93	65	38	1022	1016	1009	10	10	10	21	10	-	0.00	Rain
16	11	6	1	5	2	-1	93	70	50	1023	1022	1021	10	10	10	21	13	-	0.00	Rain
17	10	8	7	7	6	4	100	90	76	1020	1016	1013	10	9	5	21	11	-	0.00	Rain
18	7	6	6	6	5	3	100	91	81	1015	1013	1012	10	10	6	32	21	-	0.00	Rain
19	10	6	2	5	3	1	93	78	66	1016	1015	1014	10	10	10	24	18	-	0.00	Rain
20	11	6	2	6	4	1	100	79	58	1016	1014	1012	10	10	10	23	8	-	0.00	
21	12	9	7	9	7	5	93	88	77	1015	1013	1012	10	9	5	21	13	-	0.00	
22	16	12	8	11	9	8	100	85	63	1022	1018	1015	10	4	0	23	13	-	0.00	Fog
23	19	12	6	14	10	6	100	87	68	1027	1025	1022	10	8	1	21	8	-	0.00	Fog , Thunderstorm
24	21	16	11	16	13	10	100	87	73	1030	1029	1027	10	7	4	19	6	-	0.00	Fog
25	18	14	11	13	11	10	100	88	64	1031	1030	1028	10	3	0	27	14	42	0.00	Fog
26	19	14	9	11	9	8	100	76	52	1030	1028	1025	10	9	7	29	14	-	0.00	Fog
27	19	14	9	12	11	9	100	81	56	1025	1023	1020	10	7	1	19	11	-	0.00	Fog
28	21	13	7	13	11	6	100	83	56	1020	1019	1017	10	8	0	32	10	-	0.00	Fog
29	16	13	10	12	10	9	100	93	77	1019	1017	1016	10	6	1	21	14	-	0.00	Fog
30	13	11	10	11	11	10	100	97	88	1017	1017	1016	10	7	2	19	13	-	0.00	Rain
31	15	12	9	13	11	8	100	97	87	1019	1016	1015	10	8	2	23	8	-	0.00	Rain


F
Temperature
Dew Point
Normal High/Low
C
in Hg
Barometric Pressure
hPa
mph
Wind Speed
Wind Gust
km/h
Wind Dir (deg)

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