



# Aughinish Alumina Ltd.

Askeaton, Co. Limerick  
IPPC Licence Reg. P0035-05



Annual Environmental Report  
2012

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**Aughinish Alumina Ltd.**  
**Integrated Pollution Prevention & Control Licence**  
**Register No. P0035-05**

**Annual Environmental Report 2012**

**March 2013**

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## 1. Introduction

This document comprises the fourteenth Aughinish Alumina Limited (AAL) Annual Environmental Report (AER).

The report covers the period from the 1<sup>st</sup> January 2012 to the 31<sup>st</sup> December 2012 and has been prepared in accordance with the Environmental Protection Agency (EPA) 'Guidance Note on the Annual Environmental Report' and other relevant guidance as provided by the EPA on their website ([www.epa.ie](http://www.epa.ie)).

### 1.1 Description of the Activity

AAL was granted a revised Integrated Pollution Prevention and Control Licence (IPPC) in October 2012. The Licence grants AAL permission to carry out the following activities in accordance with the requirements and conditions as set out in the Licence:

- ❖ The production of basic inorganic chemicals
- ❖ The operation of combustion installations with a rated thermal input exceeding 50MW
- ❖ The recovery or disposal of waste in a facility

This IPPC Licence (Reg. No. P0035-05) supersedes the installation's previous licence (Reg. No. P0035-04), which was issued in 2008.

The AAL plant extracts alumina from bauxite using the Bayer Process, a chemical method that has been developed and refined over the past century and is used by over 40 alumina extraction plants worldwide.

Approximately 70% of the bauxite processed by AAL comes from Guinea in West Africa with the remainder coming from Brazil. The finished product, alumina, is exported for further processing through smelting to aluminium metal.

The production output of the plant in 2012 was 1,924,385 tonnes of alumina hydrate representing an increase of approximately 0.1% over 2011 production levels.

### 1.2 Management Structures

Since March 2008, AAL has been wholly owned by United Company RUSAL, which is the largest integrated aluminium company worldwide.

AAL has a structured management approach to the operation of the business in terms of product quality, process control, environment, safety, training and analytical capability. Training of personnel is a key function in the successful operation of the plant.

The IPPC Licence requires the company to establish and maintain an Environmental Management System (EMS) and the conditions of the licence outline the form that the EMS should take at AAL. In order to demonstrate its commitment to environmental protection, AAL has gained certification of its EMS to the international standard ISO 14001:2004.

Safety, environmental and quality management systems are audited on an on-going basis by a combination of internal audit teams and external certification surveillance audits by our certification body Det Norske Veritas (DNV UK).

**Table 1 Management Systems at AAL**

<b>Year</b>	<b>System</b>	<b>Accreditation Body</b>
1993	International Safety Rating System (ISRS)	DNV
1995	ISO 9002 Quality Management System	DNV
2000	ISO 14001:2004 Environmental Management System	DNV

### 1.3 Organisational Structure

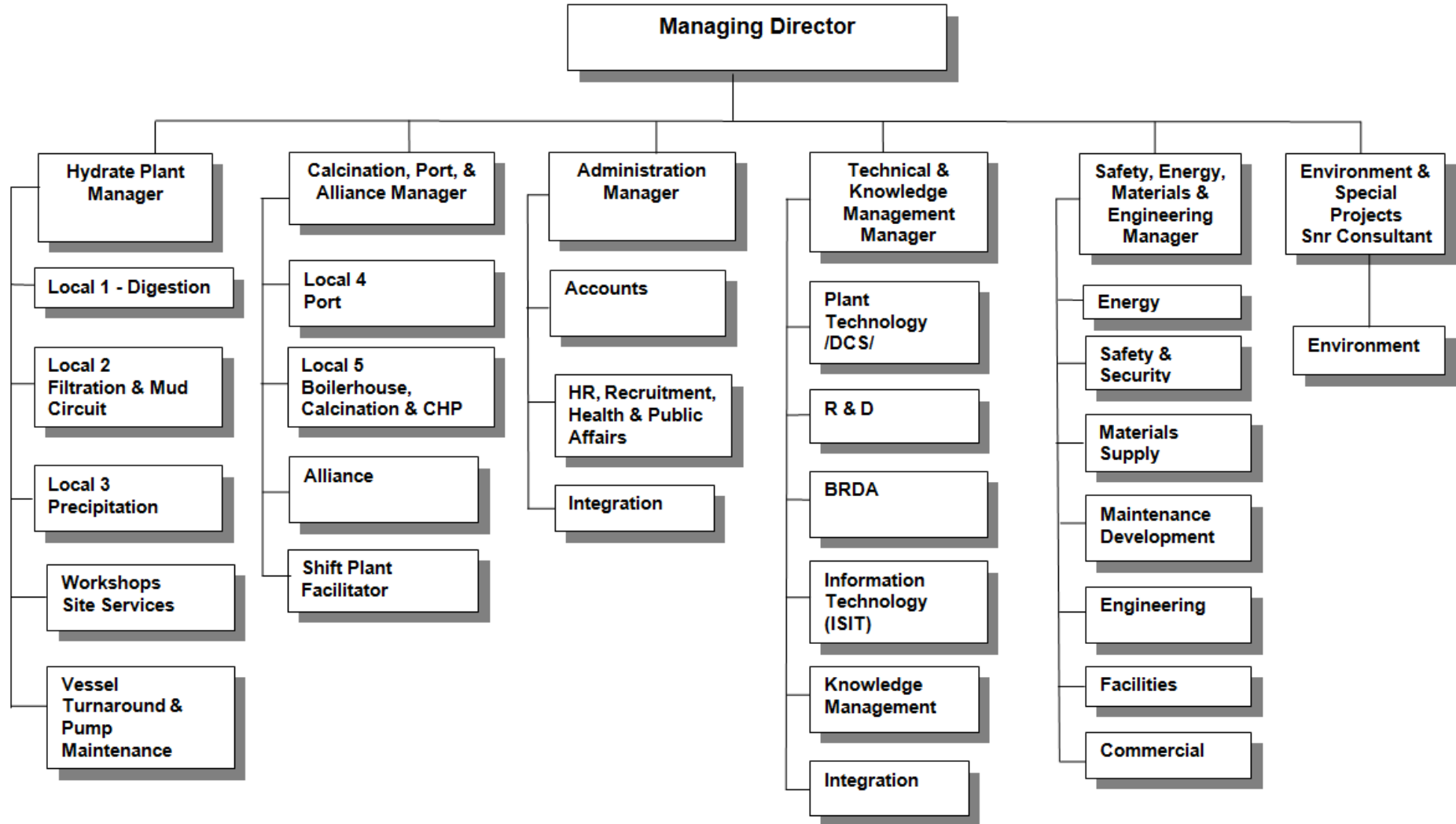
AAL operates a relatively flat management structure with a strong emphasis on team working. The company structure for 2012 is set out in the organogram overleaf and outlines the responsibility for day-to-day management of environmental issues at the plant.

The Environmental Co-ordinator has overall responsibility for environmental management and reports directly to the Management Team.


The Environmental Co-ordinator is supported in the day-to-day activities by the Environmental Engineer(s), who have responsibility for the maintenance of the Environmental Management System, undertaking specific projects of an environmental nature and evaluating compliance with the IPPCL.

The Environmental Technologists are responsible for environmental monitoring activities including sampling and analysis of all emissions and discharges from the site.


The Contractor Alliance comprises three main contractor companies providing various engineering, operational and maintenance services all of whom are based on-site. As part of contractor induction training, an Environmental Manual is issued to each contractor. This contains information on site environmental requirements and instructions for environmental management and control to ensure compliance with the IPPCL. Contractors are regularly updated through regular training and safety briefings.



## 1.4 Environmental Policy



# Statement of Environmental Policy



*Protection of the environment is a high priority for every employee, contractor and director of RUSAL Aughinish. This objective requires our full co-operation in a continuing effort to improve our products and production processes.*

*The process we employ at RUSAL Aughinish, the 'Bayer Process', is the accepted industrial method for the manufacture of alumina world-wide. Our principal product, smelter grade alumina, is used to manufacture aluminium, a metal with many recognised environmental benefits.*

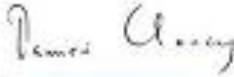
*Successful integration of our environmental objectives with our health, safety, quality and cost objectives is required to ensure our competitive position.*

*We will continue to:*

- *Comply with all legal requirements and where appropriate, use more stringent internal standards based on our expertise.*
- *Use world class practices to ensure that we prevent pollution and meet social, economic and environmental demands.*
- *Develop opportunities with suppliers and customers to improve our products and to minimise waste and environmental impacts.*
- *Make effective use of environmental management systems that continually improve our performance consistent with defined goals.*
- *Review our environmental objectives and targets regularly to ensure that these remain both relevant and appropriate to our operations.*
- *Communicate with employees, consumers, communities, businesses and government to achieve greater environmental understanding.*
- *Ensure that RUSAL Aughinish's environmental policy is communicated to all employees and contractors and is made available to the public.*


*By fulfilling these objectives, we will have due regard to the environmental expectations of our many stakeholders.*

signed:



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Damien Clancy MD  
October 11, 2011



## 1. Emissions

AAL implements a comprehensive environmental monitoring programme to assess the significance of emissions from site activities. The programme includes emissions to air, effluent discharges, surface water and waste monitoring. An overview of the results of the monitoring conducted during 2012 is presented in this section.

This section also includes an evaluation of compliance with the conditions and schedules of the IPPCL, together with a summary of environmental incidents reported to the Agency during 2012. Any external complaints received by AAL during 2012 are detailed, together with a description of the investigations and corrective actions initiated as a result of those complaints.

Summary information on all emissions, discharges and waste arising from operations at AAL has been submitted to the Agency via the AER/PRTR Annual Environmental Reporting website. Monitoring data, summarised in the following sections, shows continued compliance with IPPC Licence conditions and emission limit values.

## 2.1 Emissions to Air

There are 17 IPPC licensed air emission points at AAL. The primary sources of emissions to air are the Boilers (Emission Point Ref. A1), Calciners (Emission Point Ref. A2) and Combined Heat and Power Plant (CHP) (Emission Point Refs. A3-A and A3-B). IPPC Licence P0035-05 licensed a new emission point for a natural gas fired boiler to be installed in the future.

The remaining emission sources comprise bag house and cyclone exhausts for control of particulate emissions from materials handling operations and three diesel fired boilers for heating buildings.

### 2.1.1 Boiler Emissions

Boiler emissions are one of the major air emission sources on the site. Depending on the parameter, monitoring varies from continuous online monitoring, to quarterly analyses as specified in Schedule C1.1 (Control of Emissions to Air) of IPPC Licence P0035-05. A summary of the actual mass emissions for the licensed parameters during the reporting period is tabulated in Table 2 below.

Actual mass emissions of oxides of sulphur (as SO<sub>2</sub>), as tabulated below, are generated by calculation, based on the sulphur content of the fuel and the quantity of fuel oil consumed in 2012. Nitrogen oxides mass emissions (as NO<sub>2</sub>) are derived from measured NO<sub>2</sub> values, and estimated exhaust gas flow rates. Dust mass emissions from the boilers are calculated from the measured particulate emissions and estimated exhaust gas flow rates. The gas flow rate estimation is based on the quantity of fuel used, as there is a stoichiometric relationship between air flow and fuel consumption.

Licensed mass emissions are based on emissions concentration and flow rate at ELV, taking a 366 day operational period.

**Table 2 Mass Emissions to Air - Boilers 2012**

Emission Point Ref. A1 Boilers	Mass Emission (kg) 2011	Mass Emission (kg) 2012	Licensed Mass Emissions via NERP* (kg)
Oxides of Sulphur (as SO <sub>2</sub> )	1,799,077	1,620,128	4,140,000
Nitrogen Oxide (as NO <sub>2</sub> )	629,021	610,033	1,095,000
Dust	49,746	37,525	123,000

\*NERP is the National Emissions Reduction Programme

Emissions of sulphur dioxide, nitrogen oxides and dust from the main site boilers were significantly below licensed mass emission rates permitted for these parameters.

The actual mass emission of SO<sub>2</sub> from the boilers decreased by 11% in 2012 compared to the 2011 figure. Emissions of nitrogen oxides (as NO<sub>2</sub>) decreased by 3% during the same period. These reductions are due to the reduction in the quantity of fuel combusted in the boilers in 2012 versus 2011.

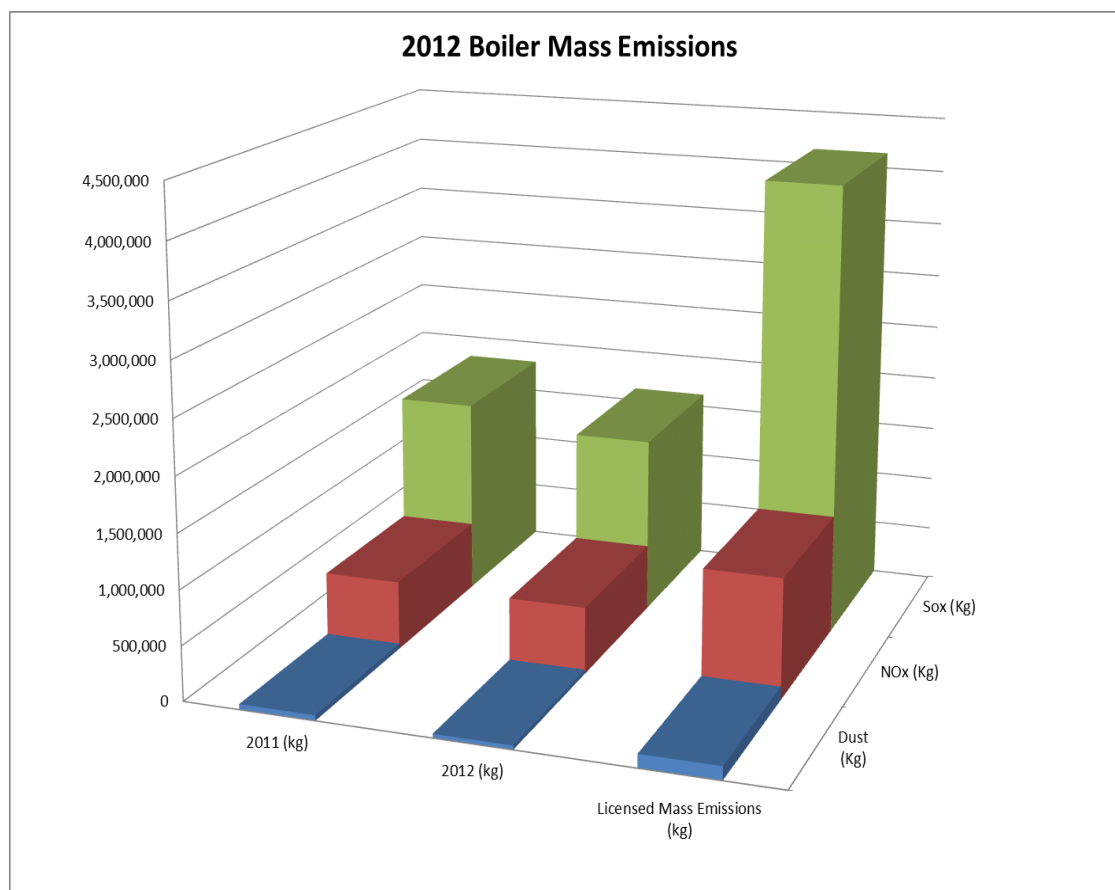


Figure 1 Boiler Mass Emissions 2012

### 2.1.2 Calciner Emissions

Emissions from the calciners are summarised in Table 3 below as actual annual mass emissions (in Kgs) for the licensed parameters during the 2012 reporting period.

Mass emissions of oxides of sulphur are generated by calculation, based on the sulphur content of the fuel and the quantity of fuel oil consumed. Particulate mass emissions are based on the measured particulates, as monitored as part of the IPPC Licence requirements, and estimated exhaust gas flow rates.

Table 3 Mass Emissions to Air - Calciners 2012

Emission Point Ref. A2 – Calciner	Mass Emission (Kgs) 2011	Mass Emission (Kgs) 2012	Licensed Mass Emissions (Kgs)
Oxides of Sulphur (as SO <sub>2</sub> )	253,606	0	6,282,317
Particulates	86,784	97,544	235,704

There were no emissions of oxides of sulphur from the calciners during 2012. This was due to conversion of all the calciners to a dual fuel combustion system during

2011 which allows the calciner units to use either natural gas or HFO as their primary fuel. In 2012, no HFO was combusted in the calciners.

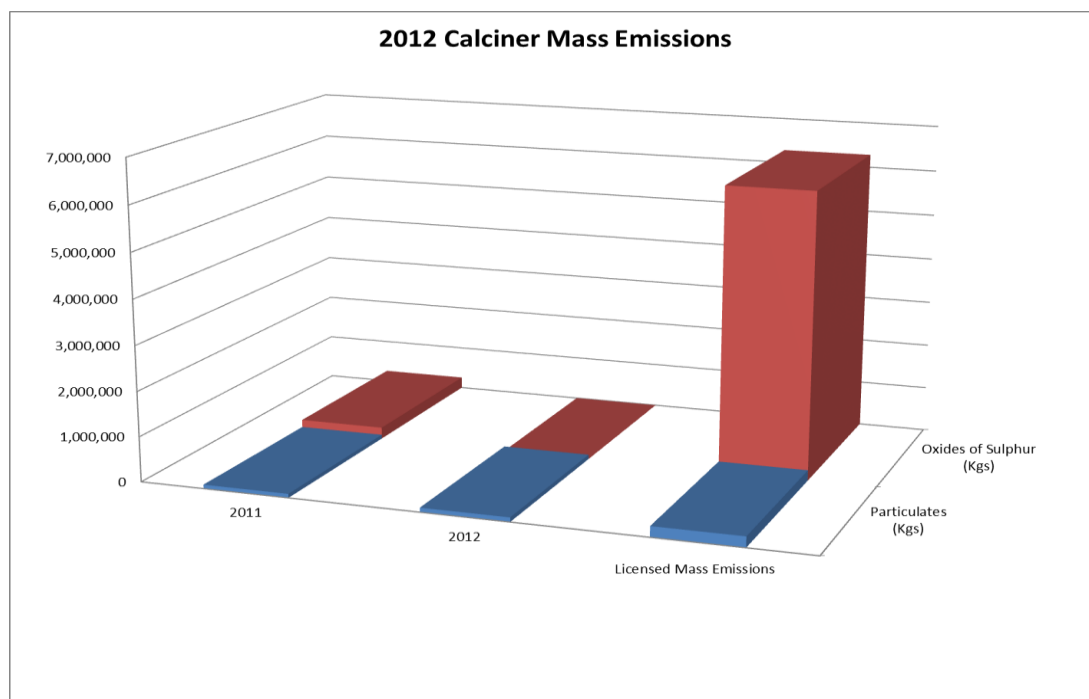


Figure 2 Calciner Mass Emissions 2012

### 2.1.3 CHP Emissions

Schedule C1.1 of the IPPCL requires the monitoring of oxides of nitrogen (NO<sub>2</sub>) in CHP stack emissions.

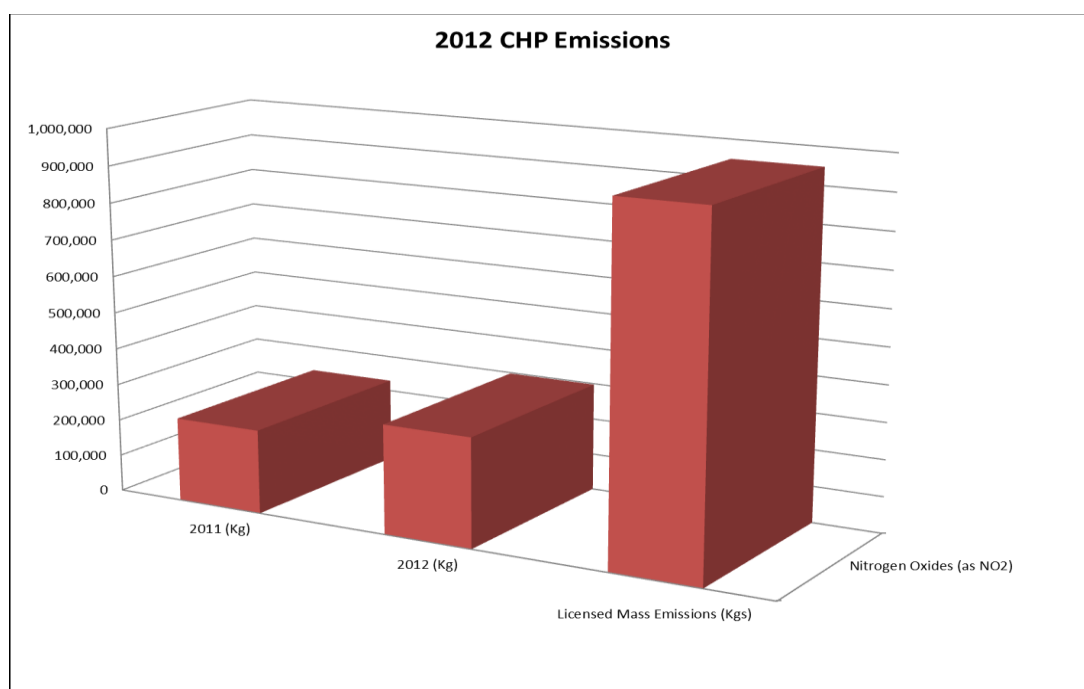
The licence requirements for the CHP heat recovery steam generator stack are as outlined below:

- ❖ No 24-hour value shall exceed the emission limit value of 75 mg/Nm<sup>3</sup>
- ❖ No hourly value shall exceed twice the ELV (150 mg/Nm<sup>3</sup>)

The NO<sub>2</sub> monitoring data for 2012 is shown in Table 4 below.

Table 4 Mass Emissions to Air - CHP 2012

Emission Point Ref. A3A & A3B – CHP	Mass Emission (Kgs) 2011	Mass Emission (Kgs) 2012	Licensed Mass Emissions (Kgs)
Nitrogen Oxides (as NO <sub>2</sub> )	229,309	297,448	948,672



**Figure 3 CHP Mass Emissions 2012**

#### 2.1.4 Other Emission Points (Dust Collection Units)

There are 9 licensed process air emission points. These emissions are from dust collection units (DCUs) associated with bauxite and alumina handling and conveying operations at the plant.

Actual mass emissions of particulates from each of the licensed emission points are tabulated below and are based on average quarterly monitoring results and total hours of operation during 2012.

Licensed mass emissions are based on discharges at the ELV over a 24 hour, 366 day operational period.

The combined actual annual mass emission of particulates from the licensed emission points was 8,581 kg during 2012 which is significantly lower than the permitted annual mass emission for the combined sources of 175,045 kg.

In addition, each individual sample collected during the quarterly monitoring events was significantly below the relevant emission limit value for that source.

**Table 5 Summary of Particulate Emissions from Dust Collection Units**

Emission Point Ref./Description		Mass Emission (Kg) 2011	Mass Emission (Kg) 2012	Licensed Emission (Kg)
5	Transfer Tower 4 & 5 Exhaust Fan	0	0	51,899
6	Bauxite Crusher Scrubber Exhaust Fan	5,132	1,495	49,168
8	Transfer Tower 3 Scrubber Exhaust Fan	0	0	21,594
11	Alumina Loader Dust Fan FA49AL03 Outer	128	95	20,716
12	Alumina Loader Dust Fan FA49A Inner	932	1,286	9,708
16	Alumina Silo 1 Exhaust Fan FA12A017	1,256	1,890	6,588
17	Alumina Silo 2 Exhaust Fan FA12A018	979	1,652	6,588
18	Alumina Silo 3 Exhaust Fan FA12A019	997	1,600	4,392
19	Alumina Silo 1/2 Exhaust Fan FA12A020	649	563	4,392
<b>Total</b>		<b>10,074</b>	<b>8,581</b>	<b>175,045</b>

There are three unmonitored licensed combustion emission points at the plant. Licensed emission points 13, 14 and 15 are associated with small scale building heating boilers in Area 73, Area 76 and Area 79 respectively. These units are fired on gas oil with less than 0.2% sulphur. There are no emission limits set for these small boilers and there is no requirement to monitor emissions.

### 2.1.5 Compliance Summary

Compliance with the relevant emission limit values (ELV's) for emissions to atmosphere is evaluated as follows for boiler, calciner and CHP emissions.

#### **Boiler Emissions**

The overall annual level of compliance with emission limit values for continuous monitoring of HFO boiler emissions to atmosphere is tabulated overleaf for the 48-hour and the monthly average compliance requirements as specified in Condition 4.1.4 of the IPPCL. The parameters evaluated are sulphur dioxide and nitrogen oxides.

- ❖ No monthly mean shall exceed the ELV (750 mg/Nm<sup>3</sup> for NO<sub>x</sub> and 1700 mg/Nm<sup>3</sup> for SO<sub>2</sub>)
- ❖ 95% of 48-hour mean values shall not exceed 825 mg/Nm<sup>3</sup> for NO<sub>x</sub>
- ❖ 97% of 48-hour mean values shall not exceed 1,825 mg/Nm<sup>3</sup> for SO<sub>x</sub>

The evaluation indicates that HFO boiler emissions were fully compliant with both the 48-hour (Table 6) and monthly average (Table 7) emission limits as specified in Condition 4.1.4 of the IPPC Licence.

**Table 6 Evaluation of Compliance with 48-hour Average ELV's – HFO Boilers 2012**

Parameter	Oxides of Sulphur (as SO <sub>2</sub> )			Nitrogen Oxides (as NO <sub>2</sub> )		
	No. Measurement Intervals	183			183	
Boiler Ref.	A	B	C	A	B	C
No. of Periods above ELV	0	0	0	0	0	0
% of 48-hour periods below ELV	100%	100%	100%	100%	100%	100%
Target % below ELV for compliance	97%	97%	97%	95%	95%	95%
<b>Compliant</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>

**Table 7 Evaluation of Compliance with Monthly Average ELV's – HFO Boilers 2012**

Parameter	Oxides of Sulphur (as SO <sub>2</sub> )			Nitrogen Oxides (as NO <sub>2</sub> )		
	# Measurement Intervals	12			12	
Boiler Ref.	A	B	C	A	B	C
No. of Periods above ELV	0	0	0	0	0	0
% of monthly periods below ELV	100%	100%	100%	100%	100%	100%
Target % monthly periods below ELV for compliance	100%	100%	100%	100%	100%	100%
<b>Compliant</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>

### **Calciner Emissions**

The requirements for Calciner particulate emissions as outlined in Condition 4.1.3 of the IPPC licence are as follows:

- ❖ No daily average value shall exceed the ELV (50 mg/Nm<sup>3</sup>)
- ❖ No hourly average shall exceed twice the ELV (100 mg/Nm<sup>3</sup>)

An evaluation of the continuous monitoring data for 2012 is summarised in Table 8.

**Table 8 Evaluation of Compliance – Calciners 2012**

<b>Parameter</b>	<b>IPPC ELV (mg/m3)</b>	<b>Actual 2012 (mg/m3)</b>	<b>Comment</b>
Daily Average Particulates	50	100% < 50 (Average = 21)	Compliant
Hourly Maximum Particulates	100	100% < 100 (Average of hourly maximum = 28)	Compliant

In addition, for non-continuous monitoring of calciner emissions conducted quarterly using an isokinetic stack sampler in accordance with IPPC Licence requirements, individual results were fully compliant with the relevant ELV's for calciner emissions.

### **CHP Emissions**

A summary of all data for CHP emissions is included in Table 9. In all cases, the emissions were compliant with the relevant ELVs.

**Table 9 Evaluation of Compliance - CHP 2012**

<b>Parameter</b>	<b>IPPC ELV (mg/m3)</b>	<b>Actual 2012 (mg/m3)</b>	<b>Comment</b>
A3-A (GT1) Daily average NO <sub>x</sub>	100% < 75	100% < 75 (Average = 18)	Compliant
A3-A (GT1) Hourly maximum NO <sub>x</sub>	100% < 150	100% < 150 (Average = 26)	Compliant
A3-B (GT2) Daily average NO <sub>x</sub>	100% < 75	100% < 75 (Average = 37)	Compliant
A3-B (GT2) Hourly maximum NO <sub>x</sub>	100% < 150	100% < 150 (Average = 44)	Compliant

### **Dust Collection Units**

Other particulate emissions are required to be sampled on a quarterly basis.

All monitoring results for each of the emission points were fully compliant with the specified emission limit values set out in the IPPC licence.

## 2.2 Emissions to Water

AAL has two licensed discharges of treated effluent to the Shannon Estuary as follows:

**Table 10 Licensed Discharges to Water**

Licence Reference	Receiving Water	Characteristics
W1-1	Shannon Estuary	Treated Industrial (Process) Effluent
Sanitary Effluent	Shannon Estuary	Treated Sanitary Effluent

Discharges of treated industrial and sanitary effluents to the Shannon Estuary are made at an outfall point close to the AAL Marine Terminal. Both discharges are sampled continuously for both flow and pH, and for other parameters at weekly, monthly, quarterly and six monthly frequencies, as specified in Schedules C.2.1 (Control of Emissions to Water) and C.2.2 (Monitoring of Emissions to Water) of the IPPCL.

### 2.2.1 Process Effluent (W1-1)

Treated process effluent is discharged to the Shannon Estuary at emission point W1-1. Summary monitoring results for 2012 are tabulated below in Table 11.

Toxicity testing, heavy metal screening and VOC (volatile organic compounds) for process effluent are detailed in Sections 2.2.2, 2.2.3 and 2.2.4 respectively.

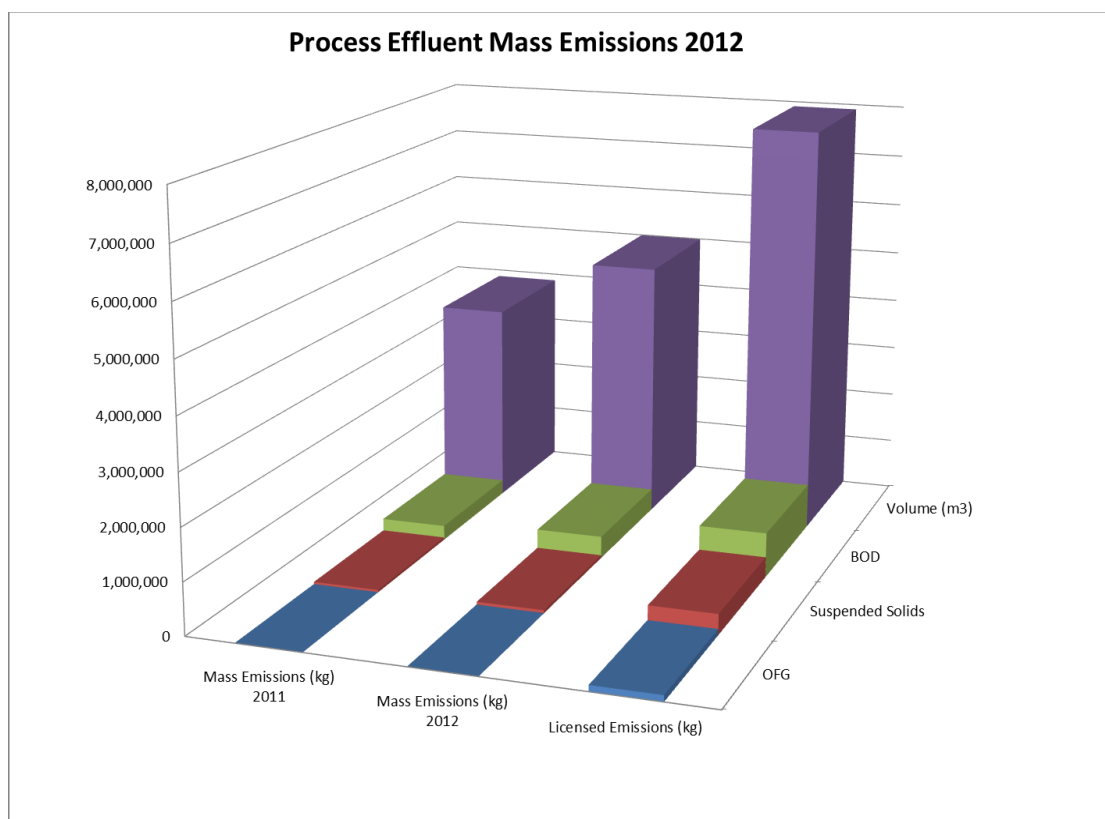
The data reported in Table 11 is for the 12 months of 2012. Figures for 2011 are included by way of comparison. It is noted that annual mass emissions for all parameters during the reporting period were within licensed emission limit values.

While hourly and daily flow values occasionally approach up to the relevant limit, annual volumetric emissions from W1-1 are significantly below the permitted ELV.

The reason for the increased volume of process effluent in 2012 is due to the fact that the new BRDA became operational in late 2011 which has increased the storm water catchment area by 80 hectares.

**Table 11 Process Effluent (W1-1) Mass Emissions 2012**

Parameters	Mass Emissions (kg) 2011	Mass Emissions (kg) 2012	Licensed Emissions (kg)
Volume (m <sup>3</sup> )	3,864,398	4,989,297	10,980,000
BOD	280,198	425,597	863,760
Suspended Solids	45,342	56,961	549,000
OFG	3,864	4,989	164,700



**Figure 4 Process Effluent Mass Emissions 2012**

### 2.2.2 Toxicity Testing

Schedule B.2 (Emissions to Water) and Schedule C.2.2 (Monitoring of Emissions to Water) of the IPPC Licence requires biannual toxicity testing of the treated effluent. The ELV for toxicity is 5 Toxic Units (TU).

Two samples of treated effluent (each consisting of 24 hour flow proportional composite samples) were collected and dispatched to the Shannon Aquatic Toxicity Laboratory (SATL) of Enterprise Ireland. These samples were collected in June and December 2012.

The acute toxicity of each sample was analysed on suitable sensitive aquatic indicator species i.e. *Tisbe battagliai* and *Vibrio fischeri*.

The results (see Table 12) show that the effluent was compliant with the ELV for toxicity.

The toxicity testing reports provided by SATL are included as Attachment 1 to this report.

**Table 12 Process Effluent - Toxicity Testing Results 2012**

Test Parameter	June 2012 Results (TU)	December 2012 Results (TU)	ELV (TU)
48h LC <sub>50</sub> to <i>Tisbe battagliai</i>	< 3.1	< 3.1	5
30 min EC <sub>50</sub> to <i>Vibrio fischeri</i>	< 2.2	< 2.2	5

Note: Values denoted less than (<) are below the relevant threshold or limit of detection for that test

### 2.2.3 Heavy Metal, Aluminium and Soda Analysis

AAL is required to analyse treated process effluent for heavy metals, aluminium and soda under IPPCL Schedule C.2.2 Monitoring of Emissions to Water.

#### Heavy Metals

Heavy metal analysis of the effluent discharged at emission point W1-1 was undertaken by FitzScientific Ltd. on a quarterly basis during 2012. Analytical results for 2012 are shown in Table 13 below.

**Table 13 Process Effluent (W1-1) - Heavy Metal Results 2012**

Parameter	Conc. (mg/l) Q1	Conc. (mg/l) Q2	Conc. (mg/l) Q3	Conc. (mg/l) Q4	Limit of Detection (mg/l)
As	0.025	0.038	0.057	0.039	0.005
Cd	0.0007	0.001	0.001	0.0003	0.0002
Cr	0.006	0.008	0.003	0.0004	0.001
Cu	0.011	0.003	0.008	0.006	0.003
Hg	0.005	0.006	0.004	0.005	0.0001
Ni	0.005	0.016	0.008	0.004	0.0025
Pb	0.0001	0.0132	<LOD	0.0006	0.001
Zn	0.013	0.005	0.004	0.004	0.003
Ti	<LOD	<LOD	<LOD	<LOD	0.004
Fe	0.024	0.085	0.077	0.062	0.001
Mg	5.805	5.377	10.305	1.987	0.001

The results of the analyses for aluminium and soda are detailed in Table 14. The figure provided for each parameter is the average result for the 2011 and 2012 monthly monitoring intervals.

**Table 14 Process Effluent (W1-1) - Aluminium & Soda Results**

Parameter	Units	Annual Average 2011	Annual Average 2012	ELV
Aluminium	mg/l Al	1.65	1.34	Not specified
Soda	g/l Na <sub>2</sub> O	2.41	2.63	Not specified

#### 2.2.4 Effluent VOC Screen

VOC screening of industrial effluent (at W1-1) is undertaken biannually as specified in Schedule C.2.2 of the IPPC Licence. Biannual sampling and analysis was undertaken in June and December 2012. Laboratory analysis was undertaken by Fitz Scientific Ltd. using a modified version of the US EPA Method 524.2, as approved by the Agency (Ref. M35/AP/12).

The VOC concentration in the sample taken in June 2012 was 5.0 µg/l and the VOC concentration in the December 2012 sample was 3.6 µg/l.

**Table 15 Process Effluent (W1-1) - VOC Screen**

Date	Units	Test	Method	Result
18/06/2012	µg/l	VOC	USEPA 542.2	5.0
04/12/2012	µg/l	VOC	USEPA 542.2	3.6

## 2.2.5 Sanitary Effluent

Treatment of sanitary effluent is provided for by a proprietary biological effluent treatment plant, which comprises an activated sludge (aeration) stage and a settlement/clarification stage, prior to discharge. The system discharges to the industrial effluent discharge pipeline at a point upstream of the final discharge at W1-1.

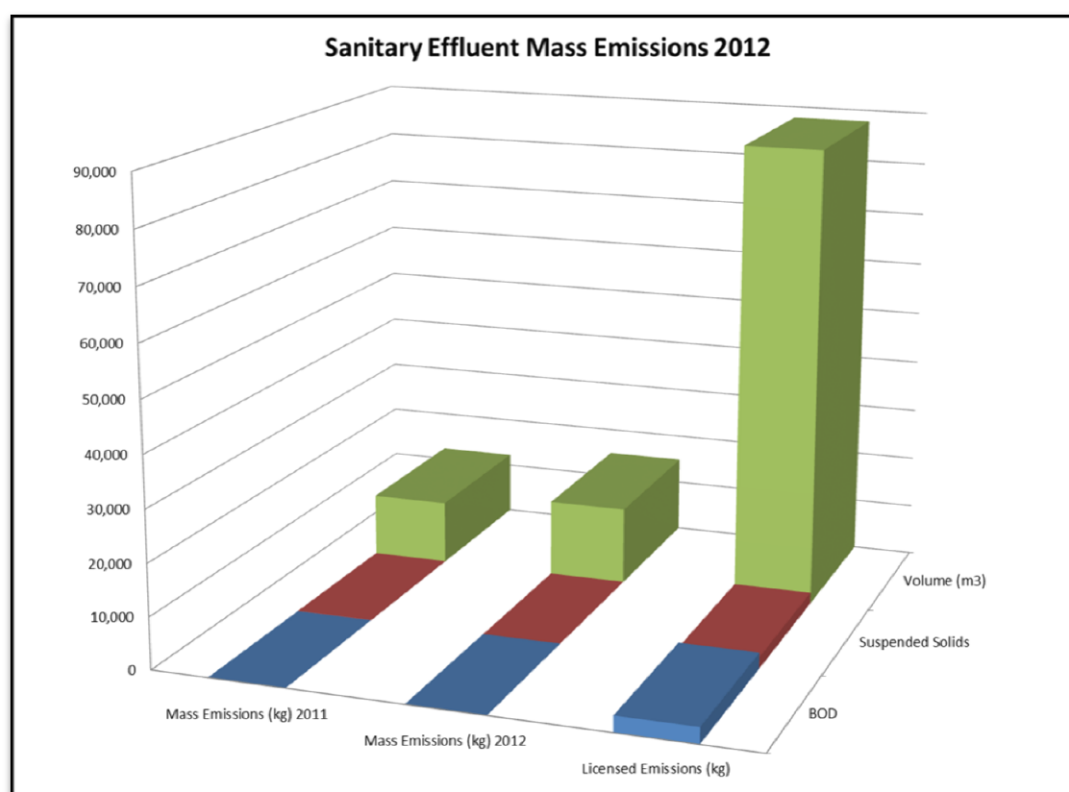
In the unlikely event that pH, BOD or suspended solids levels in the treated effluent do not meet the specified IPPC ELV's, the treated effluent is re-circulated within the system and is not discharged i.e. potentially non-compliant effluent is returned for re-treatment to ensure compliance.

Annual mass emissions for treated sanitary effluent discharges are tabulated on Table 16 below.

**Table 16 Sanitary Effluent Mass Emissions 2012**

Parameter	Mass Emissions (kg) 2011	Mass Emissions (kg) 2012	Licensed Emissions (kg)
Volume (m <sup>3</sup> )	13,555	14,907	87,840
BOD	47	72	2,196
Suspended Solids	62	40	3,074

The annual volumetric discharge mass emissions for all parameters were significantly below permitted levels for those discharges.



**Figure 5 Sanitary Effluent Mass Emissions 2012**

## 2.2.6 Surface Water Monitoring

Monitoring of surface water run-off from the site is undertaken at five discharge locations referred to as Surface Streams (SS).

Monitoring results for each emission point are summarised in Table 17 as the average value for the monitoring period.

**Table 17 Results of Surface Water Discharge Monitoring 2012**

Emission Point Reference	pH	Conductivity ( $\mu\text{S/cm}$ )	Na <sub>2</sub> O (g/l)
Frequency	Weekly	Weekly	Monthly
SS 1	8.2	120	0.011
SS 2	8.3	192	0.009
SS 3	8.3	206	0.018
SS 4	8.4	120	0.007
SS 5	8.3	329	0.030

(Note: Results are numerical average of 2012 data)

## 2.2.7 Surface Water Monitoring at the BRDA

Monitoring of surface water run-off in the area of the existing BRDA is undertaken at two licensed locations – Mangan’s Lough and the OPW Channel.

Results for each emission point are detailed in Table 18 and show the average value over the monitoring period. As the surface water in the area is subject to saline intrusion, the soda and conductivity values are subject to sodium interference owing to the presence of sodium salts in the brackish water.

**Table 18 BRDA Surface Water Monitoring Results 2012**

Description	pH	Conductivity $\mu\text{S/cm}$	Soda (Na <sub>2</sub> O) g/l
Mangan's Lough	7.0	803	0.13
OPW Channel	7.8	2,582	0.51

(Note: Results are numerical average of 2012 monthly monitoring data)

## 2.2.8 Discharges to Water Compliance Summary

All discharges of treated process wastewater and sanitary effluent complied fully with the relevant emission limit values set out in the IPPCL.

### 3. Waste Management

The national waste database table, providing a summary of waste arising at the AAL facility has been compiled for the calendar year 2012. The information is tabulated on Tables 19 and 20.

#### 3.1 Waste Quantities 2012

**Table 19 Summary Information on Waste Quantities Generated**

Year	2008	2009	2010	2011	2012
<b>Total quantity of waste produced in calendar year (tonnes)</b>	<b>1,242,451</b>	<b>996,074</b>	<b>1,252,784</b>	<b>1,342,802</b>	<b>1,305,251</b>
Total quantity of waste disposed of on-site	1,240,695	995,448	1,251,219	1,341,342	1,303,383
Total quantity of waste disposed of off-site	274	166	246	215	215
Total quantity of waste recovered on-site	0	0	0	0	382
Total quantity of waste recovered off-site	1,482	460	1,318	1,245	1,270
Year	2008	2009	2010	2011	2012
<b>Quantity of Non-hazardous waste produced in calendar year (tonnes)</b>	<b>1,265,311</b>	<b>980,752</b>	<b>1,235,628</b>	<b>1,322,599</b>	<b>1,289,351</b>
Quantity of non-hazardous waste disposed of on-site	1,263,666	980,210	1,234,162	1,321,264	1,287,575
Quantity of non-hazardous waste disposed of off-site	256	136	231	202	195
Quantity of non-hazardous waste recovered on-site	0	0	0	0	382
Quantity of non-hazardous waste recovered off-site	1,389	406	1,234	1,134	1,199
Year	2008	2009	2010	2011	2012
<b>Quantity of Hazardous waste produced in calendar year (tonnes)</b>	<b>12,669</b>	<b>15,322</b>	<b>17,156</b>	<b>20,203</b>	<b>15,900</b>
Quantity of hazardous waste disposed of on-site	12,558	15,238	17,057	20,079	15,808
Quantity of hazardous waste disposed of off-site	18	30	15	14	20.5
Quantity of hazardous waste recovered on-site	0	0	0	0	0
Quantity of hazardous waste recovered off-site	93	54	84	111	71

The quantities of waste disposed of to the plant Bauxite Residue Disposal Area (BRDA) are estimated using a number of methods:

- Volumes of red mud disposed of to the BRDA are calculated from the annual production figures and the determined mud factor generated by analysis of the bauxite ores used during the reporting period.
- Volumes of salt cake, process scale and other process wastes are based on the number of containers multiplied by typical container net weight. As such, the degree of accuracy is of the order of  $\pm 10\%$  on these figures.

There was an overall decrease of 37,532 tonnes of waste generated on site in 2012 compared to 2011. This decrease was primarily due to the improved quality of raw bauxite which led to a reduction in residual bauxite following alumina extraction.

Results of waste analysis carried out by AAL during 2012 are included as Attachment 2.

**Table 20 Information on Individual Waste Streams**

EWC Code	Haz (Y/N)	Description of Waste	Name of Waste Collection Contractor (where applicable)	Waste Collection Permit No.	Name of Waste Disposal/ Recovery Contractor(s) (where applicable)	Method of Disposal/Recovery	Location of Disposal/ Recovery	Waste Licence/ Permit No.	Quantity (Tonnes/ annum)
15 01 11	Y	Aerosol Cans	John Malone Transport	WCP-LK-543-08b	Rilta Environmental Ltd., Greenogue Business Park, Rathcoole, Co. Dublin	D10 Incineration on land	(b) Off-site Abroad	W0192-03	5.00
17 06 01	Y	Asbestos	John Malone Transport	WCP-LK-543-08b	Rilta Environmental Ltd., Greenogue Business Park, Rathcoole, Co. Dublin	D1 Deposit on, in or under land	(c) Off-site Abroad	W0192-03	5.5
16 06 01	Y	Batteries (lead-acid)	John Malone Transport	WCP-LK-543-08b	Rilta Environmental Ltd. Greenogue Business Park, Rathcoole, Co. Dublin	R4 Recycling/reclamation of metals & metal compounds	(b) Off-site Ireland	W0192-03	8.62
20 01 01	N	Cardboard	Greenstar	WCP-DC-08-1120-01	Greenstar, Dock Road, Limerick	R3 Recycling/reclamation of organic substances which are not used as solvents	(b) Off-site Ireland	W0082-02	15.4
18 01 04	Y	Clinical Waste	SRCL	WCP-DC-09-1178-01	SRCL Ltd., 420-430 Beech Road, Western Industrial Estate, Naas Road, Dublin 12	D9 Physico chemical treatment	(b) Off-site Ireland	W0055-02	0.028
20 01 99	N	Conveyor Belting	Quarry Plant Supplies	N/A	Pat O'Connor, Quarry Plant Supplies, Straffan, Co. Kildare	R11 Uses of residual materials obtained from any of the operations numbered R1-R10	(b) Off-site Ireland	N/A	31.9
17 04 01	N	Copper	Hegarty Metals Recycling	WCP-LK-027-02b	Hegarty Metals Recycling, Ballysimon Rd., Limerick	R4 Recycling/reclamation of metals & metal compounds	(c) Off-site Abroad	WFP-LKC-11-001-01	28.3
16 11 04	N	Flue Stack Residue (Boiler Ash)	N/A	N/A	Aughinish Alumina Ltd.	D1 Deposit on, in or under land	Site landfill	IPPCL P0035-05	3.0

EWG Code	Haz (Y/N)	Description of Waste	Name of Waste Collection Contractor (where applicable)	Waste Collection Permit No.	Name of Waste Disposal/ Recovery Contractor(s) (where applicable)	Method of Disposal/Recovery	Location of Disposal/ Recovery	Waste Licence/ Permit No.	Quantity (Tonnes/ annum)
16 11 04	N	Flue Stack Residue (Refractory Waste)	N/A	N/A	Aughinish Alumina Ltd.	D1 Deposit on, in or under land	Site landfill	IPPCL P0035-05	80
20 01 21	Y	Fluorescent & Mercury Containing Bulbs	Irish Lamp Recycling	WCP-DC-08-1115-01	Irish Lamp Recycling, Athy, Co Kildare	R4 Recycling/reclamation of metals & metal compounds	(b) Off-site Ireland	WFP-KE-08-0348-01	11.00
20 03 01	N	General Waste	Greenstar	WCP-DC-08-1120-01	Greenstar, Dock Road, Limerick	D1 Deposit on, in or under land	(b) Off-site Ireland	W0082-02	179.0
16 05 04	Y	Halon Cylinders	John Malone Transport	WCP-LK-543-08b	Rilta Environmental Ltd. Greenogue Business Park, Rathcoole, Co. Dublin	R5 Recycling/reclamation of inorganic substances	(c) Off-site Abroad	W0192-03	0.68
01 03 99	N	Lime Grits/Stone	N/A	N/A	Aughinish Alumina Ltd.	D1 Deposit on, in or under land	Site landfill	IPPCL P0035-05	5,590
15 01 04	N	Metal Containers (empty IBC's & drums)	John Malone Transport	WCP-LK-543-08b	Rilta Environmental Ltd., Greenogue Business Park, Rathcoole, Co. Dublin	R4 Recycling/reclamation of metals & metal compounds	(b) Off-site Ireland	W0192-03	12.5
16 01 07	Y	Oil Filters	Enva	WCP-DC-08-1116-01	Enva Shannon, Smithstown Industrial Estate, Shannon, Co. Clare	R11 Uses of residual materials obtained from any of the operations numbered R1-R10	(b) Off-site Abroad	W0041-01	0.10

EWC Code	Haz (Y/N)	Description of Waste	Name of Waste Collection Contractor (where applicable)	Waste Collection Permit No.	Name of Waste Disposal/ Recovery Contractor(s) (where applicable)	Method of Disposal/Recovery	Location of Disposal/ Recovery	Waste Licence/ Permit No.	Quantity (Tonnes/ annum)
13 08 99	Y	Oily Rags / Oil Dry	John Malone Transport	WCP-LK-543-08b	Rilta Environmental Ltd. Greenogue Business Park, Rathcoole, Co. Dublin	D10 Incineration on land	(b) Off-site Ireland	W0192-03	10.0
20 01 01	N	Paper/ Documents	DGD Papers	WCP/LK/021/02 b, WCP/LK/021/05 c WCP/LK/062/02 b	DGD Papers Ltd., Bay M1, Raheen Business Park, Limerick	R3 Recycling/reclamation of organic substances which are not used as solvents	(b) Off-site Ireland	WFP-LK-2008-09C	1.1
20 01 39	N	Plastic containers (clean IBC's, drums)	John Malone Transport	WCP-LK-543-08b	Rilta Environmental Ltd., Greenogue Business Park, Rathcoole, Co. Dublin	R9 Used oil re-refining or other reuses of previously used oil	(b) Off-site Ireland	W0192-03	45.2
15 01 10	Y	Plastic containers (contaminated IBC's & drums)	SRCL	WCP-DC-09-1203-01	SRCL Ltd./Ecosafe Systems, 420-430 Beech Road, Western Industrial Estate, Naas Road, Dublin 12	R12 Waste exchange prior to recovery	(b) Off-site Abroad	W0055-02	2.9
20 01 36	N	Printer Toner Cartridges	Condells	N/A	Condells The Office Centre, 9 Roches St., Limerick	R4 Recycling/reclamation of metals & metal compounds	(b) Off-site Ireland	N/A	0.08
01 03 09	N	Red Mud	N/A	N/A	Aughinish Alumina Ltd.	D1 Deposit on, in or under land	Site landfill	IPPCL P0035-05	1,183,358
01 03 99	N	Process waste (tank cleanout scale, sludge etc.)	N/A	N/A	Aughinish Alumina Ltd.	D1 Deposit on, in or under land	Site landfill	IPPCL P0035-05	16,709
01 03 07	Y	Salt Cake	N/A	N/A	Aughinish Alumina Ltd.	D1 Deposit on, in or under land	Site landfill	IPPCL P0035-05	15,808

EWCode	Haz (Y/N)	Description of Waste	Name of Waste Collection Contractor (where applicable)	Waste Collection Permit No.	Name of Waste Disposal/ Recovery Contractor(s) (where applicable)	Method of Disposal/Recovery	Location of Disposal/ Recovery	Waste Licence/ Permit No.	Quantity (Tonnes/ annum)
01 03 99	N	Sand	N/A	N/A	Aughinish Alumina Ltd.	D1 Deposit on, in or under land	Site landfill	IPPCL P0035-05	81,835
19 08 05	N	Sanitary Effluent Sludge	N/A	N/A	Aughinish Alumina Ltd.	D2 Land Treatment	Designated area on-site	IPPCL P0035-05	381.9
17 04 07	N	Steel & Aluminium Scrap Metal	Hegarty Metals Recycling	WCP-LK-027-02b	Hegarty Metals Recycling, Ballysimon Rd., Limerick	R4 Recycling/reclamation of metals & metal compounds	(c) Off-site Abroad	WFP-LKC-11-001-01	918.3
20 01 38	N	Timber Reels (used)	Hegarty Metals Recycling	WCP-LK-027-02b	Hegarty Metals Recycling, Ballysimon Rd., Limerick	R11 Uses of residual materials obtained from any of the operations numbered R1-R10	(b) Off-site Ireland	WFP-LKC-11-001-01	33.1
19 12 04	N	Used Hosing (Rubber)	Greenstar	WCP-DC-08-1120-01	Greenstar, Dock Road, Limerick	R11 Uses of residual materials obtained from any of the operations numbered R1-R10	(b) Off-site Ireland	W0082-02	31.5
20 01 25	N	Vegetable Oils & Greases	Frylite	WCP-DC-10-1297-01	Frylite Dublin Ltd., Unit J1, Ballymount Industrial Estate, Dublin 12	R3 Recycling/reclamation of organic substances which are not used as solvents	(b) Off-site Ireland	WCP-DC-10-1297-01	1.2
16 02 14	N	Waste Electrical & Electronic Equipment (WEEE)	Greenstar	WCP-DC-08-1120-01	Greenstar, Dock Road, Limerick	R4 Recycling/reclamation of metals & metal compounds	(b) Off-site Ireland	W0082-02	3.0
20 01 38	N	Wood - recycling	Hegarty Metals Recycling	WCP-DC-08-1120-01	Greenstar, Dock Road, Limerick	R3 Recycling/reclamation of organic substances which are not used as solvents	(b) Off-site Ireland	W0082-02	77.8
20 01 38	N	Wood - landfill	Hegarty Metals Recycling	WCP-DC-08-1120-01	Greenstar, Dock Road, Limerick	D1 Deposit on, in or under land	(b) Off-site Ireland	W0082-02	15.8

EWC Code	Haz (Y/N)	Description of Waste	Name of Waste Collection Contractor (where applicable)	Waste Collection Permit No.	Name of Waste Disposal/ Recovery Contractor(s) (where applicable)	Method of Disposal/Recovery	Location of Disposal/ Recovery	Waste Licence/ Permit No.	Quantity (Tonnes/ annum)
13 01 13, 13 07 01	Y	Waste Oil	John Malone Transport	WCP-LK-543-08b	Rilta Environmental Ltd., Greenogue Business Park, Rathcoole, Co. Dublin	R9 Used oil re-refining or other reuses of previously used oil	(b) Off-site Ireland	W0192-03	38.4
16 07 08	Y	Waste Oil/Water Washings	Lehane Environmental	WCP-CK-08-0574-02	Rilta Environmental Ltd. Greenogue Business Park, Rathcoole, Co. Dublin	R9 Used oil re-refining or other reuses of previously used oil	(b) Off-site Ireland	W0192-03	9.32



Hazardous Waste



Non Hazardous Waste

## 4. Monitoring and Enforcement

### 4.1 Monitoring

The EPA, and their representatives, made 3 separate monitoring visits during 2012. On 2 occasions, Agency personnel collected samples of treated process effluent and sanitary effluent. During these site visits, the Agency personnel also inspected the site surface water streams and samples were collected from SS-5. One monitoring visit was carried out by Catalyst Environmental Ltd. on behalf of the EPA during which emissions to air from the calciner stack (Emission Point Ref. A2) were monitored.

Results for all samples collected were compliant with the relevant schedules and conditions of the IPPC licence.

Summarised data from Agency site monitoring visits is tabulated in Table 21 and Agency monitoring results are summarised in Tables 22, 23 and 24.

**Table 21 Number of EPA Site Visits 2012**

No. of Monitoring Visits	3	No. Exceedences	Compliance Rate (%)
Total No. of Samples	8	0	100%
Parameters Monitored (Water)	42	0	100%
Parameters Monitored (Air)	5	0	100%

**Table 22 EPA Industrial Effluent Results (Emission Ref. W1-1)**

Parameter	EPA Result Range	IPPCL ELV
pH	8.1 – 8.75	6 – 9
Solids(mg/l)	<2 – <16	50
BOD (mg/l)	<LOD - 10	2360 (kg/day)

For all samples collected by the Agency, results were compliant with the emission limit values as stated in Schedule B.2 of the IPPC Licence.

**Table 23 EPA Sanitary Effluent Results**

Parameter	EPA Result Range	IPPCL ELV
pH	7.8 - 8.1	6 – 9
Solids(mg/l)	<8 – 29	35
BOD (mg/l)	1.2 – 2.4	25

In all cases, sanitary effluent results were compliant with the relevant ELV's.

**Table 24 EPA Emissions to Air Results (Calciner Stack A2)**

Parameter	Max EPA Result	IPPCL ELV
Particulates	21.7 mg/m <sup>3</sup>	50 mg/m <sup>3</sup>

## **4.2 Third Party Inspections**

AAL obtained certification to the international environmental management system (EMS) standard ISO14001 in 2000.

DNV-QA (Det Norske Veritas Quality Assurance) carried out a detailed audit of the system in November 2012. No non-conformances with ISO14001 were raised during this audit.

AAL operates a rigorous internal audit schedule in order to ensure conformance with plant operating systems (production, quality, safety, environmental) and to facilitate the process of continual improvement in those systems.

## 5. Resource Consumption

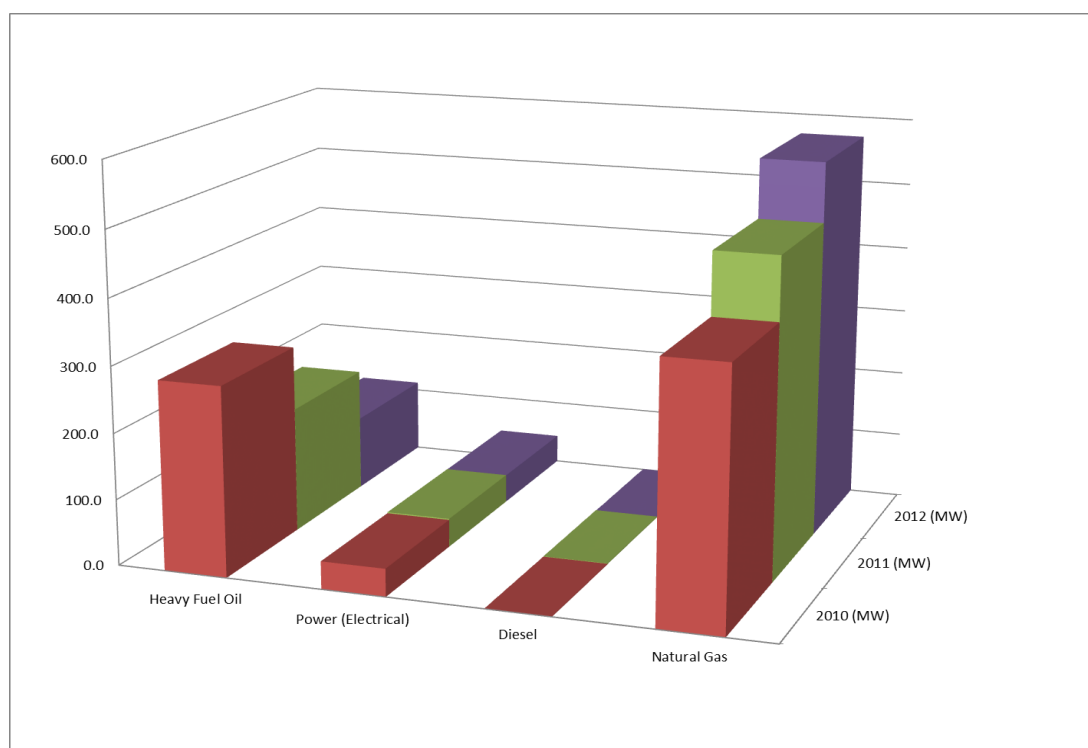
### 5.1 Energy Consumption

Owing to the nature of the Bayer process used at AAL for alumina manufacturing and post extraction processing, energy represents the most economically significant impact to the process.

For this reason, AAL was designed with energy efficiency in mind. Heat recovery and power efficiency are two of the key process efficiency targets that receive close scrutiny.

**Table 25 Summary Energy Data 2008 to 2012**

Source	2008 (MW)	2009 (MW)	2010 (MW)	2011 (MW)	2012 (MW)
Heavy Fuel Oil	258.8	172.4	286.2	189.7	112.6
Power (Electrical)	42.1	31.5	41.9	43.4	43.1
Diesel	2.8	0.9	0.9	1.3	0.5
Natural Gas	392.7	375.5	384.0	479.5	569.8
<b>Total</b>	<b>696.4</b>	<b>580.2</b>	<b>712.9</b>	<b>713.8</b>	<b>725.9</b>



**Figure 6 Energy Use 2010 - 2012**

### 5.1.1 Energy Efficiency Report 2012

The 2012 energy efficiency report is attached to this document as Attachment 3.

### 5.2 Water Consumption

AAL receives potable water from Limerick County Council for process and domestic uses.

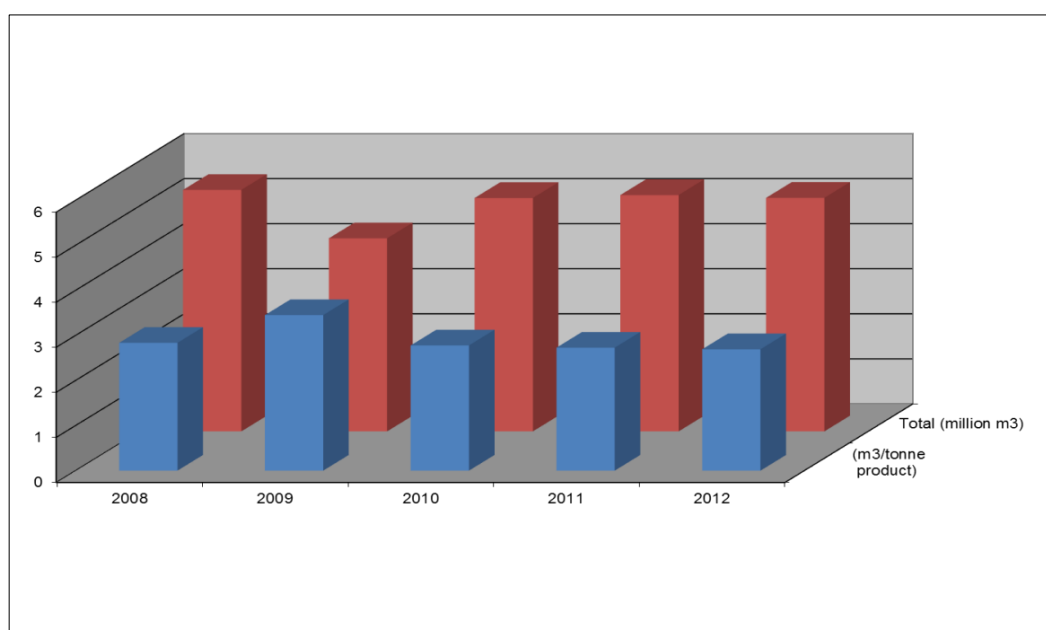
The bulk of the potable water is demineralised in the AAL water treatment plant for use in boiler steam generation. The balance of the potable water is used for process make-up, where process condensate (re-condensed water from the process) supply is not available, and also as domestic water.

AAL does not abstract any groundwater for process or domestic purposes.

There was a slight decrease in water usage by the plant in 2012 as a result of a minor improvement in steam efficiency (see Table 26). The relative consumption of water (m<sup>3</sup> per tonne of alumina hydrate produced) decreased slightly during 2012 versus 2011 and is similar to consumption rates seen in previous years.

**Table 26 Summary Water Consumption Data 2008 to 2012**

Year	Total (m <sup>3</sup> )	Relative Consumption (m <sup>3</sup> /tonne product)
2012	5,182,967	2.69
2011	5,245,081	2.73
2010	5,179,203	2.78
2009	4,284,051	3.45
2008	5,368,168	2.84



**Figure 7 Plant Water Consumption**

## **6. Environmental Incidents and Complaints**

In the event of an environmental incident occurring, AAL informs the EPA and, where appropriate, Limerick County Council and Inland Fisheries Ireland in accordance with the conditions of the IPPC Licence.

AAL has a procedure for classification and reporting of environmental incidents. The procedure was revised in 2011 to include the requirements of the EPA Revised Guidance to Licensees/COA Holders on the Notification, Management and Communication of Environmental Incidents issued in December 2010.

As part of the requirements of the IPPC Licence, AAL operates, through the plant Environmental Management System, a procedure for logging and responding to complaints received from the public.

### **6.1 Category 1 Incidents**

There were two Category 1 (minor) incidents notified to the EPA during 2012:

- Spillage of process liquor to the ground following the flooding of a process bund caused by an unexpected power outage in the plant on the 31<sup>st</sup> of January 2012. The bulk of the spillage was recovered back into the plant process thereby minimising environmental damage.
- Discharge of approximately 100 litres of discoloured water at Surface Stream 5 on the 18<sup>th</sup> of May 2012. The source of this water was a minor discharge of dilute bauxite slurry dust from the Bauxite ore Transfer Tower 3 dust collection skip. This material was inert and contained no process chemicals.

### **6.2 Category 2 – 5 Incidents**

There were no Category 2, 3, 4 or 5 (Limited, Serious, Very Serious or Catastrophic) environmental incidents during 2012.

### **6.3 Complaints**

Two complaints were received during 2012. Details are as follows:

On the 15<sup>th</sup> March 2012, AAL received correspondence from the EPA containing a complaint regarding AAL received by the Agency from a member of the public in Askeaton, Co. Limerick. The complaint referred to an alleged air pollution event on the 5<sup>th</sup> March. AAL reviewed all emissions data corresponding to that date and found that all emissions were compliant with the relevant IPPC emission limit values. A letter detailing the findings of the review of the emission data was sent to the EPA.

On the 26<sup>th</sup> May 2012, AAL received a complaint by telephone from a member of the public regarding possible dusting in the BRDA. BRDA operations were reviewed and it was found that all dust control measures (automatic sprinklers on the mud and water bowsers on the roads) had been activated to prevent any dusting. Dust gauge data for the period of the complaint was reviewed and found to be below the internal limit of 350mg/m<sup>2</sup>/day.

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## **7. Environmental Management**

Section 7 of this AER contains summary information on the AAL Environmental Management Programme (EMP).

A revised Schedule of Objectives and Targets for 2013 is presented in Section 7.2 for Agency approval.

Both the EMP and Schedule of Objectives and Targets fall under the site ISO 14001 Environmental Management System. Accordingly, they are included within a structured system of management review and periodic auditing by both internal auditors and independent third party auditors (DNV).

The Pollution Release and Transfer Register (PRTR), which is a requirement of Condition 6.17 of the IPPCL, has been updated to reflect emissions during the 2011 monitoring period.

### **7.1 Environmental Management Programme (EMP) Report 2012**

The AAL Environmental Management Programme (EMP) is a continuously updated plan showing the status of key environmental improvement programmes being undertaken within the plant and is reviewed as part of the ISO 14001 Environmental Management System (EMS).

Progress in achieving planned objectives and targets during 2012 is summarised in this section. It sets out the objectives, associated targets and a comment on progress in meeting those targets.

During 2012, significant progress was achieved in a number of key areas related to reduced emissions to air, improvements in quality assurance of CEMS, improvement in groundwater quality and development of a suitable method for neutralisation of bauxite residue.

In addition, it is noted that significant work is undertaken on an on-going or recurring basis at the plant in order to continuously maintain and update AAL plant environmental performance.

A summary of the progress in meeting a number of the plant targets during 2012 is provided overleaf.

**Table 27 EMP 2012 Report**

No.	Objective	Target	Progress
1	Improve Air Quality & reduce CO <sub>2</sub> emissions	Secure funding for the installation of a natural gas boiler to replace an existing HFO boiler. HFO use is ~100 ktonne per year (down from 350 ktonne/year) and this will reduce it to ~30 ktonnes/year.	Funding secured for natural gas boiler, installation likely to take place in 2014. Planning permission successfully obtained.
2	Operate the on-site landfill (BRDA) to best practice	Commission BRDA Phase 2 without environmental impact.	BRDA Phase 2 successfully commissioned.
3	Partially neutralise bauxite residue deposited in BRDA	Develop methodology for atmospheric carbonation and neutralisation of bauxite residue in the BRDA. Emphasis is on farming techniques during wet months.	Methodology for partial neutralisation of bauxite residue in the BRDA successfully developed. As per Condition 8.4.19 of IPPC Licence P0035-05 the Mud Farming methodology will be documented.
4	Eliminate sources of groundwater contamination & implement remediation programme for historic contamination in plant area	Install groundwater recovery pumps at the POWs identified as having the highest pH (funding dependent).	Recovery pumps installed in POW's 1 & 13.
		Achieve 100% compliance on Integrity Testing Programme & implement planned repairs for 2012.	2012 Integrity Testing Programme implemented and planned repairs completed.
5	Caustic Mass Balance	Close the caustic balance for 2012.	Closed caustic balance for 2012. Calculation has reached the limit of accuracy based on analytical methods used.
6	Reduction of BOD in industrial effluent discharged to the Shannon	Effectiveness of bacterial reduction of BOD to be assessed during 2012 to determine future direction of programme.	Programme reviewed and proposal sent to EPA as part of the last IPPC Licence review. Condition addressing effluent BOD reduction was removed from new IPPC Licence P0035-05.

**Table 27 EMP 2012 Report (Contd)**

No.	Objective	Target	Progress
7	Implement recommendations of Closure Plan as per Residues Solutions Residue Management Sustainability report	Construct & commence operation of a constructed wetlands area for treatment of BRDA leachate in conjunction with the University of Limerick & the IAI (International Aluminium Institute).	Wetlands area constructed within the BRDA for leachate treatment trial. Research will proceed during 2013.
8	Implement recommendations of Golders Associates Breakout Study report	Construct gabion barrier protection at the toe of the external embankment of the BRDA to proof against climate change driven increased levels of storms.	Construction works rescheduled to 2013.
9	Improve quality assurance of continuous emission monitors (CEMS) for emissions to air and meet requirements of EU Standard EN 14181.	Conduct 'Annual Surveillance Testing' as required under EN14181.	Annual Surveillance Testing carried out during 2012
		Boiler Particulate online monitor performance to be improved.	Boiler particulate online monitors re-calibrated during 2012. Performance being assessed to identify possible further improvements.
10	Reduce fugitive emissions	Minimise on-site alumina dusting at alumina storage silos and Jetty ship loading points.	Improvements works carried out during 2012 at alumina storage silos and jetty loading points.

## 7.2 Environmental Objectives and Targets 2013

AAL reviews the plant Environmental Management System on an on-going basis with the aim of updating and refining the Environmental Management Programme (EMP) to take account of progress in meeting objectives and targets.

In addition, new targets are added on the basis of achievement of existing targets and where issues have been identified as requiring a formal and structured EMP approach to drive their implementation.

New targets, which have been added for 2013 are summarised overleaf in Table 28. This list highlights only those targets added to the EMP and excludes the significant work involved in on-going programmes and projects to achieve existing targets, the detail of which is set out in the EMP for 2012.

The primary focus of the EMP in achieving significant environmental objectives during 2013 will be the implementation of the new IPPC Licence conditions with

regard to the BRDA as well as to continue the progress in recent years towards improving air emissions by the increased use of natural gas.

**Table 28 EMP Objectives and Targets 2013**

No.	Objective	Target
1	Operate the BRDA to best practice	Install upgraded automatic sprinkler system in Phase 1
		Implement mud farming for partial neutralisation
		Increase effluent disposal capacity to 1250 m <sup>3</sup> /hr
		Demonstrate that farmed mud is non-hazardous
2	Implement recommendations of Golders BRDA Breakout Study report	Implement Gabion basket wall at the toe of the external embankment.
3	Implement recommendations of Residues Solutions report	Test constructed wetland for treatment of BRDA leachate.
4	Implement new monitoring & reporting of BRDA operations	Implement new Licence Monitoring & Reporting Conditions
		Prepare BRDA Extractive Waste Management Plan
		Prepare BRDA Safety Manual
		Prepare BRDA Water Balance & Management Plan
		Prepare BRDA Internal Emergency Plan and liaise with Limerick County Council on BRDA External Emergency Response Plan
		Agree Mud Farming procedures and agree test methods for assessment of neutralised mud
		Define scope for BRDA biennial audit
		Issue progress reports on rehabilitation & break-out study.
5	Improve air quality & reduce CO <sub>2</sub> emissions	Secure funding for the installation of 2 natural gas boilers onsite to replace an existing HFO boilers (which will be retained as strategic back-up)
6	Improve quality assurance of continuous emission monitors (CEMS) for emissions to air. Must meet requirements of EU Standard EN 14181.	Conduct 'Annual Surveillance Testing' as required under EN14181.
		Improve boiler particulate monitors calibration
		Improve calciner particulate monitor calibration
		Define start-up and shutdown for boilers, gas turbines and calciners as per IED requirements

**Table 28 EMP Objectives and Targets 2013 (contd)**

No.	Objective	Target
7	Reduce fugitive emissions	Reduce alumina dusting at jetty & alumina storage silos
8	Improve groundwater quality	<p>Achieve 100% compliance on Integrity Testing Programme &amp; implement planned repairs for 2013.</p> <p>Commission groundwater assessment as per requirements of Condition 6.15.4 of IPPCL.</p> <p>Install groundwater recovery pumps at the POWs identified as having the highest pH (funding dependent)</p> <p>Install silt traps &amp; oil separators on surface water streams</p> <p>Proposal on integrity testing of all open process drains to be submitted to the Agency</p> <p>Implement monthly inspection and recording of leaks from all external valves and flanges</p>
9	Conduct Caustic Mass Balance	Close the process caustic balance for 2013.

### 7.3 Pollutant Release and Transfer Register (PRTR)

The Pollutant Release and Transfer Register (PRTR) have been updated to provide further data for the calendar year 2012. Based on the emissions arising from the boilers and calciners, and also emissions which currently appear on the European Pollutant Emission Register (EPER), the following substances are included in the PRTR for 2012;

- Sulphur dioxide (SO<sub>2</sub>)
- Oxides of nitrogen (as NO<sub>2</sub>)
- Particulate matter
- Carbon dioxide
- Arsenic
- Cadmium
- Chromium
- Copper
- Nickel
- Zinc
- Mercury
- Lead
- Aluminium
- Iron
- Magnesium
- Biological oxygen demand

- Fats, oils and greases
- Suspended solids

Sulphur dioxide mass emissions are based on measured 'S' concentration in HFO multiplied by HFO consumption rate.

Nitrogen dioxide and particulate mass emissions have been calculated based on results of direct stack gas measurement multiplied by calculated stack gas flow rates.

Carbon dioxide and heavy metal emissions have been calculated based on fuel consumption multiplied by the appropriate emission factor.

Emission factors used for calculations Hg, Cr and Cu are based on Ireland specific emission factors for oil fired power plant. All other emission calculations are based on UK NAEI dataset for fuel oil fire power stations.

**Table 29 PRTR Summary for 2012**

<b>Emissions to Air (tonnes)</b>					
<b>Source</b>	<b>CHP</b>	<b>Calciner</b>	<b>Boiler</b>	<b>Total (Tonnes)</b>	<b>Method of Measurement</b>
<b>Pollutant Name</b>					
Oxides of Sulphur (as SO <sub>2</sub> )	7	3	1,620	<b>1,630</b>	E & M
Nitrogen oxides (as NO <sub>2</sub> )	297	539	610	<b>1,446</b>	E & M
Particulates	N/A	98	38	<b>135</b>	E & M
Carbon Dioxide**	758,496	313,365	288,904	<b>1,360,766</b>	E & M
Arsenic	N/A	0.000	0.011	<b>0.011</b>	C
Cadmium	N/A	0.000	0.012	<b>0.012</b>	C
Chromium	N/A	0.000	0.014	<b>0.014</b>	C
Copper	N/A	0.000	0.014	<b>0.014</b>	C
Mercury	N/A	0.000	0.002	<b>0.002</b>	C
Nickel	N/A	0.000	0.505	<b>0.505</b>	C
Lead	N/A	0.000	0.028	<b>0.028</b>	C
Zinc	N/A	0.000	0.041	<b>0.041</b>	C

The full PRTR is included as Attachment 4. This document has also been submitted to the Agency via the AER/PRTR Reporting Website.

AAL proposes to monitor and report the same parameters for the 2013 PRTR.

### 7.3.1 Caustic Mass Balance

AAL have continued to undertake a detailed evaluation of caustic flows within the process during 2012. This work has continued on previous mass balance exercises undertaken at the plant over the past few years in order to further close out the quantity of caustic which is unaccounted for.

The mass balance undertaken during 2012, and tabulated below in Table 30, has closed off the input-output cycle and resolved caustic consumption at the plant to approximately 1kg caustic (sodium hydroxide) per tonne of alumina hydrate produced. This is likely to be due to margins of error in sampling and measurement of caustic concentrations of minor streams which are based on periodic grab samples.

**Table 30 Results of Caustic Mass Balance 2012**

<b>Element</b>	<b>Units (kg/tH)</b>
<b><i>Input</i></b>	
Total Caustic Consumption	61.6
<b><i>Outputs</i></b>	
Caustic in Mud	53.3
Caustic in Alumina	4.2
Caustic in Alumina Hydrate Ships	0.2
Caustic in Sand to BRDA	0.5
Caustic in Saltcake to BRDA	2.7
Caustic in process scale from Tank Turnarounds shipped to BRDA	0.2
Caustic in West pond disposal to the BRDA (Storm Water Pond)	5.3
Caustic in treated (neutralized & clarified) industrial effluents to the river	-2.5
Caustic recovery to process from the BRDA	-1.0
<b><i>Total Output</i></b>	<b>62.8</b>
<b><i>Unaccounted</i></b>	<b>-1.1</b>

## 8. Other Reports

This section contains details of other once off projects and reports required under the various conditions of the IPPC Licence.

Generally, where documentation has already been submitted to the Agency, summarised information is provided. Full text reports are included as attachments where relevant.

Monitoring data from annual surveys (noise) together with results from ambient air quality, dust deposition and groundwater monitoring are summarised.

Updates to the facility Closure, Restoration and Aftercare Management Plan (CRAMP), the Environmental Liabilities Risk Assessment (ELRA) and the costings and financial provisions associated with both are provided.

The landfill status report (BRDA Operational Plan) is a recurring requirement of the IPPCL and has been updated to reflect quantities of waste deposited and development works undertaken during the 2012 calendar year.

### 8.1 Noise Monitoring Programme

AAL is required to carry out an annual noise survey in accordance with IPPC Licence Conditions 4.5 and 6.16. Schedule B.4 sets out the relevant noise limits at off-site noise sensitive locations (NSL) as:

- Day-time: 55 dB (A)  $L_{eq}$
- Night-time: 45 dB (A)  $L_{eq}$

A survey of noise levels at boundary and off-site noise sensitive locations was carried out in July and August 2012. At each monitoring location, day and night-time measurements were made for the following measurement parameters:  $LA_{eq}$ ,  $LA_{max}$ ,  $LA_{min}$ ,  $LA_{90}$  and  $LA_{10}$ .

The monitoring results are summarised on Table 31 and 32.

**Table 31 Noise Survey Results – Noise Sensitive Locations**

Location	Day-time			Night-time		
	$LA_{eq}$	$LA_{90}$	$LA_{10}$	$LA_{eq}$	$LA_{90}$	$LA_{10}$
NSL 1	49	46	51	44	39	43
NSL 2	53	43	53	46	34	38
NSL 3	51	43	51	37	34	39
NSL 4	46	41	47	46	32	37
NSL 5	53	42	52	39	34	38

Noise levels measured at noise sensitive receptors (primarily close to dwellings) during day-time periods ranged from  $L_{Aeq}$  46 dB(A) to 53 dB(A) with corresponding  $LA_{90}$  values ranging from 41 dB(A) to 46 dB(A).

The night-time  $LA_{eq}$  values recorded ranged from 37 dB(A) to 46 dB(A) with corresponding  $LA_{90}$  values ranging from 32 dB(A) to 39 dB(A).

During both survey periods, the noise climate at all off-site noise sensitive receptors was dominated by road traffic on the N69, road traffic to and from the AAL facility, operations in Foynes Port, wind generated noise and birdsong.

The noise limit of 45 dB(A) for night-time periods was marginally exceeded at two locations (NSL2 and NSL4). However there was no audible noise coming from the facility at these locations at the time of the survey and the monitored  $LA_{90}$  values which are representative of background noise were significantly below the 45 dB(A) limit. The predominant noise recorded at NSL2 was road traffic noise from the N69 and the predominant noise recorded at NSL4 was noted to be emanating from Foynes Port.

The noise limit of 55 dB(A) for day-time periods was not exceeded at any of the noise-sensitive receptor locations.

**Table 32 Noise Survey Results – Boundary Locations**

Location	Day-time			Night-time		
	$LA_{eq}$	$LA_{90}$	$LA_{10}$	$LA_{eq}$	$LA_{90}$	$LA_{10}$
B1	55	52	55	66	64	67
B2	56	55	57	51	50	52
B3	53	47	56	52	36	41
B4	52	43	52	36	35	37
B5	42	36	45	30	27	30
B6	52	48	54	51	50	52
B7	45	40	47	30	28	36
B8	42	36	45	36	28	32
B9	53	45	55	53	45	55

Noise levels measured at plant boundary locations during day-time periods ranged from  $L_{Aeq}$  42 dB(A) to 56 dB(A).

Noise levels measured at plant boundary locations during night-time periods ranged from  $L_{Aeq}$  30 dB(A) to 66 dB(A).

The study concluded that AAL is compliant with respect to noise levels emanating from the facility. The full text of the noise survey report is included as Attachment 5.

## 8.2 Groundwater Monitoring

AAL undertakes an extensive groundwater monitoring programme. Overall, 87 groundwater monitoring locations have been established with the agreement of the Agency and are routinely monitored in accordance with Schedule C.8 of the IPPCL. The current IPPCL does not specify limit values for groundwater quality.

Monitoring locations can be categorised into the following:

- (i) **Estuarine Springs (ES)** are foreshore springs which discharge from the limestone bedrock at the foreshore (ES1 - 16)
- (ii) **Plant Observation Wells (POW)** beneath the process plant (POW1 - 33); the area around the south pond (SPW1 - 6) and the north pond (NPW1 - 3) and the boreholes (BH1 - 4) in the underground fuel storage tank area.
- (iii) **Observation Wells (OW)** around the perimeter of the Phase 1 and Phase 2 BRDA (OW1-45) installed within estuarine alluvium, glacial till and limestone bedrock.

### 8.2.1 Estuarine Springs

Estuarine springs (referred to as ES's) are locations where the water table level intersects ground level to allow groundwater to directly discharge to the surface. The ES's are therefore accepted as the main indicators of groundwater quality beneath the plant area. Sixteen individual estuarine springs have been identified and are routinely monitored (ES1 - 16).

Table 33 contains a summary of monitoring results for the 2012 reporting period. Reporting is as per Schedule C.8 of the IPPC Licence.

**Table 33 Estuarine Spring Monitoring Results 2012**

Emission Point Ref.	pH*	Conductivity ( $\mu\text{S/cm}$ )	Soda (g/l)
ES 1**	12.1	2,495	1.42
ES 2	7.9	23,108	5.43
ES 3	8.1	10,396	2.33
ES 4	No Flow	No Flow	No Flow
ES 5	8.2	323	0.03
ES 6	No Flow	No Flow	No Flow
ES 7	7.4	1,114	0.16
ES 8	9.3	7,745	1.68
ES 9	8.1	10,317	2.31
ES 10	7.8	1,398	0.21
ES 11	8.0	2,518	0.52
ES 12**	11.8	4,542	1.25
ES 13	8.7	411	0.08
ES 14	8.3	1709	0.34
ES 15	8.3	582	0.10
ES 16	9.0	957	0.28

\*Numerical average of the data for the reporting period

\*\*Spring recovered for treatment - no direct discharge to estuary

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The results show that there has been a gradual and sustained improvement in the quality of the spring discharges and that only three currently have pH >9 ; ES1, ES8 and ES12. It should be noted that there is no direct discharge to the Estuary from ES1 and ES12 as these streams are intercepted and pumped to the effluent plant for treatment.

### **8.2.2 Plant Observation Wells (POW)**

Table 34 contains a summary of plant observation well (POW) groundwater monitoring results for 2012. The table also includes data for those wells located around the north effluent pond (NPW) and the south effluent pond (SPW).

Monitoring results are reported to the Agency in the quarterly monitoring reports. The values reported here are the average of analytical results returned during the 2012 monitoring period.

**Table 34 POW Monitoring Results 2012**

POW	pH	Condu ctivity	Total Alk.	Cl	Fl	Soda	Al	As	Cd	Cr	Cu	Fe	Pb	Mg	Hg	Ni	SO4	Ti	Zn
Ref.		µS/cm	mg/l CaCO <sub>3</sub>	mg/l	mg/l	g/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	µg/l	µg/l	mg/l SO <sub>4</sub>	µg/l	µg/l
POW 1	12.4	9,895	2,616	441	2.3	2.2	132,100	41	0.1	6.9	2.0	36	1.1	0.4	1.2	9.3	1157	<5	2.5
POW 2	10.0	1,781	199	116	0.5	0.45	15,430	15.5	<0.09	<2.14	1.0	55	1.06	4.66	0.3	3.1	465	<5	2.5
POW 3	10.6	2,820	228	163	0.8	0.91	1,128	11.4	<0.09	<0.93	0.9	31	<0.38	0.66	0.3	1.2	799	<5	<4.6
POW 5	12.6	16,945	8,088	75	6.4	4.2	1,528	250.5	0.4	<2.14	4.6	10	0.9	<0.55	4.4	27.7	177	<5	5.8
POW 6	9.2	501	106	11	0.2	0.49	684	1.2	<0.09	1.9	1.7	143	0.8	1.4	0.2	0.3	99	12. 7	4.3
POW 7	9.7	264	136	4	0.2	0.07	1,350	1.1	<0.09	<2.14	0.7	2,540	0.91	0.8	0.17	<0.47	4	<5	4.3
POW 8	8.3	706	92	53	0.08	0.1	35	<0.96	<0.09	<0.93	0.4	976	0.67	10.0	<0.2	<0.47	141	<5	<0.41
POW 9	7.8	517	210	24	0.1	0.04	32	<0.1	<0.09	3	0.7	153	0.69	2.9	0.13	0.5	8	<5	2.5
POW 10	7.9	431	203	12	0.1	0.02	44	<0.96	<0.09	<2.14	1.4	147	0.37	0.9	0.22	0.3	58	<5	2.6
POW 11	12.1	4,617	1,699	31	2.1	1.09	67,070	57.7	0.3	1.55	5.1	45	4.02	0.5	1.57	0.5	45	<5	4.7
POW 12	11.5	2,752	1,296	31	1.4	0.72	58,640	48.7	0.1	2.2	4.1	78	1.0	<0.55	1.4	1.3	29	<5	<0.41
POW 13	10.6	1,567	827	27	0.9	0.4	53,820	35.3	0.1	<2.14	3.1	113.5	0.7	<0.55	0.7	1.0	486	<5	7.3
POW 14	7.2	832	346	23	0.2	0.07	20	<0.1	<0.09	<2.14	1.7	4,758	1.1	3.7	0.13	1.0	<1.56	<5	2.7
POW 15	7.5	1,228	577	44	0.2	0.25	109	1.6	<0.09	18.8	1.1	1,628	<0.38	8.5	0.27	0.9	<0.75	<5	<4.6
POW 16	10.6	3,100	1,487	32	2.4	0.94	7,690	33.4	0.6	2.1	3.6	456	4.7	<0.55	1.0	4.0	33	6.4	<4.6
POW 17	13.1	45,950	15,694	76	27	10.4	601,500	668	1.1	7.1	12.3	80	3.0	<0.55	18.0	22	123	<5	24.0
POW 18	12.2	4,663	1,786	36	59.3	1.08	99,920	60.3	0.2	<2.14	3.1	90	2.0	<0.27	1.3	0.6	45	<5	2.6
POW 19	12.1	5,068	1,996	38	2.0	1.21	101,800	64.2	0.2	<0.93	0.7	433	1.6	<0.55	1.6	2.4	57	<5	2.8
POW 20	11.5	3,086	1,349	32	1.5	0.83	84,670	41.4	0.1	9.7	21.6	182	1.3	<0.55	1.2	5.1	32	<5	4.5
POW 21	8.3	548	151	57	0.1	0.07	149	0.6	<0.09	<2.14	0.8	287	1.3	10.0	0.4	0.4	30	<5	2.5

POW	pH	Condu - ctivity	Total Alk.	Cl	Fl	Soda	Al	As	Cd	Cr	Cu	Fe	Pb	Mg	Hg	Ni	SO4	Ti	Zn
Ref.		µS/cm	mg/l CaCO <sub>3</sub>	mg/l	mg/l	g/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	µg/l	µg/l	mg/l SO <sub>4</sub>	µg/l	µg/l
POW 22	8.6	276	83	22	0.1	0.04	156	<0.96	<0.09	42.3	2.1	138	0.8	2.8	0.13	2.3	14	<5	4.7
POW 23	8.4	310	102	23	0.1	0.04	70	<0.1	<0.09	<2.14	1.5	90	0.5	0.4	<0.2	0.6	22	<5	4.1
POW 24	9.5	697	238	64	0.3	0.18	1,199	7.4	<0.09	<2.14	1.5	32.8	<0.38	3.0	0.1	0.7	33	<5	<0.41
POW 25	8.0	489	152	50	0.1	0.06	206	0.9	<0.09	<2.14	0.9	167	0.8	7.2	0.2	1.1	22	<5	3.5
POW 28	10.4	1,077	606	27	0.8	0.32	49,870	21.2	0.1	<2.14	4.2	37	1.0	0.68	0.7	0.3	14	<5	7.3
POW 29	9.5	1,298	754	35	1.2	0.40	31,660	11.9	<0.09	<0.93	4.0	74	1.2	3.0	0.5	3.5	22	<5	10.1
POW 30	7.5	602	214	28	0.09	0.03	17	<0.1	<0.09	<2.14	1.6	157	0.7	6.9	0.12	2.2	36	<5	<4.6
POW 31	7.8	622	217	37	0.05	0.08	52	0.9	<0.09	<2.14	1.7	691	0.6	5.0	0.19	0.5	34	<5	2.9
POW 32	8.9	729	301	47	0.54	0.2	567	2.4	<0.09	<2.14	2.0	310	0.92	2.8	0.4	0.7	26.5	<5	2.5
POW 33	8.3	965	390	66	0.4	0.26	62	0.6	<0.09	<2.14	1.7	738	<0.38	3.9	<0.2	0.7	29	<5	3.3
SPW 1	8.6	3,162	110	342	0.2	0.8	48	1.8	<0.09	<0.93	2.6	72	1.9	17.7	0.3	1.1	1078	<5	2.5
SPW 2	8.4	1,283	140	46	0.2	0.11	104	0.6	<0.09	1.7	1.0	31	1.1	3.2	0.2	0.4	139	<5	2.5
SPW 3	7.7	437	188	16	0.3	0.02	639	1.1	<0.09	1.89	0.5	115	<0.38	4.5	<0.2	<0.47	6	<5	2.7
SPW 4	8.1	288	112	15	0.2	0.02	190	0.7	<0.09	<2.14	0.6	32	0.5	3.2	<0.2	<0.14	8	<5	2.5
SPW 5	8.5	1,022	171	25.5	0.4	0.3	62	0.8	<0.09	1.6	0.7	12.8	0.6	3.0	0.2	<0.47	276.5	<5	2.5
SPW 6	8.8	263	80	14	0.2	0.06	1,126	0.4	<0.09	5.5	1.7	216	0.9	0.7	0.19	0.3	22	110. 2	4.4
NPW 1	10.1	1,027	430	26	0.4	0.31	689	1.5	<0.09	<2.14	1.1	45	0.5	<0.27	0.2	0.4	70	<5	2.5
NPW 2	9.9	1,530	727	45	1.68	0.48	19,650	11.5	<0.09	<0.93	0.6	49	0.41	2.1	1.2	4.0	106.1	<5	2.6
NPW 3	7.9	396	178	25	0.1	0.03	39	<0.1	<0.09	<0.93	0.8	51	<0.38	4.0	0.02	0.2	12	<5	<0.41

Alk. = Alkalinity  
Cl = Chloride  
Fl = Fluoride

\*POW 4, 26 and 27 have been decommissioned

### **8.2.3 BRDA Observation Wells (OW)**

Table 35 contains a summary of summary of BRDA Observation Well (OW) groundwater monitoring results for 2012 as per Schedule C.8 of the IPPCL. The current IPPCL does not set out limit values for groundwater quality.

Monitoring results are reported to the Agency in the quarterly monitoring reports. The values reported here are the average of analytical results returned during the 2012 monitoring period.

In April 1997, OW's 3, 4, 5 and 6 were capped as part of an extension of the original BRDA. OW's 7, 8, 16, 17, 18, 19 and 23 were decommissioned during 2010 as part of the Phase 2 BRDA extension. OW's 9, 10, 11 and 12 are subject to saline intrusion and accordingly, the measured electrical conductivity, chloride and soda ( $\text{Na}_2\text{O}$ ) values are subject to interference.

A review of the monitoring results for pH in 2012 indicate that pH is below 9 in all wells.

**Table 35 BRDA OW Monitoring Results 2012**

OW Ref.	pH	Conductivity mS/cm	Total Alk. mg/l CaCO3	Cl mg/l	Fl mg/l	Soda g/l	Al µg/l	As µg/l	Cd µg/l	Cr µg/l	Cu µg/l	Fe µg/l	Pb µg/l	Mg mg/l	Hg µg/l	Ni µg/l	SO4 mg/l SO4	Ti µg/l	Zn µg/l
OW 1	8.2	1,639	355	145	0.7	0.4	43.9	1.2	<0.09	<2.14	2.6	27.6	2.31	16.3	<0.2	0.3	228.7	<5	190.9
OW 2	8.8	1,950	346	237	1.2	0.5	462	9.98	<0.09	<2.14	1.4	75	1.53	13.8	0.2	0.2	199.8	<5	21.3
OW 9	7.2	12,068	709	3,584	1.2	2.7	<11	5.24	<0.09	<2.14	2.7	2142	0.61	105.5	<0.2	1.1	454	<5	10.27
OW 10	7.3	29,388	141	11,023	1.0	6.2	20	0.88	<0.09	<2.14	1.8	1001	0.26	722.8	<0.2	2.6	691.5	<5	2,315
OW 11	7.2	31,050	1,966	10,862	0.5	7.5	30	0.14	<0.09	3.1	0.3	35	<0.38	620.6	<0.2	0.6	180.3	5.8	19.6
OW 12	7.5	28,020	1,441	9,728	0.5	6.6	26	0.57	<0.09	<2.14	1.2	446	<0.38	554.6	<0.2	1.5	325.5	<5	15.31
OW 13	7.7	477	199	17	<0.5	0.02	37	<0.1	<0.09	<2.14	2.8	60	0.21	5.4	<0.2	0.5	3.0	<5	6.9
OW 14	7.5	580	238	35	<0.5	0.02	35	<0.1	<0.09	<2.14	3.1	28	<0.38	5.1	<0.2	0.3	9.7	<5	4.50
OW 15	7.6	591	255	20	<0.5	0.01	28	0.18	<0.09	<2.14	1.7	22	<0.38	5.2	<0.2	0.8	9.0	<5	2.88
OW 20	7.6	3,077	562	594	1.25	0.65	40	0.22	<0.09	<2.14	4.7	161	0.15	32.1	0.1	6	144	<5	4.3
OW 21	7.2	31,225	2,326	10,911	<0.5	7.11	22	0.54	<0.09	2.10	1.5	606	0.134	813.1	<0.04	1.78	<0.75	<5	2.6
OW 22	7.0	5,018	462	1,129	1.00	0.86	4	0.40	<0.09	<2.14	1.60	461	6.54	43.3	<0.2	11.5	118.3	<5	10.8
OW 24	7.1	14,588	890	4,298	0.87	3.50	<11	3.89	<0.09	<0.93	1.50	498	0.20	222.9	<0.2	9.5	797.2	<5	98.4
OW 25	7.0	19,938	1002	6,172	0.61	4.97	24	3.89	<0.09	2.35	1.38	3351	0.17	222.9	<0.2	3.5	1238.0	<5	11.9
OW 26	7.4	7,025	709	2,649	0.62	2.42	33	1.79	<0.09	<0.93	1.44	454	1.32	62.0	<0.2	4.4	373.3	<5	31.2
OW 27	7.1	15,373	586	4,775	0.67	3.48	22	0.17	<0.09	<0.93	1.40	471	1.31	210.8	<0.2	2.0	809.6	<5	135.4
OW 28	7.1	14,118	669	4,371	1.03	3.19	27	0.74	<0.09	<0.93	1.57	572	1.24	281.1	<0.2	4.3	664.1	<5	16.2
OW 29	7.2	17,113	826	5,412	1.07	3.97	17	2.37	<0.09	<0.93	2.08	1834	0.16	284.0	<0.2	5.7	772.3	<5	8.2
OW 30	7.0	3,281	571	442	0.65	0.42	32	1.19	<0.09	<0.93	2.25	189	0.17	55.0	<0.2	0.8	429.1	<5	11.3
OW 31	7.0	8,105	748	2,304	0.84	1.69	14	3.99	<0.09	<0.93	2.40	375	0.17	267.9	<0.2	3.8	439.5	<5	6.3
OW 32	6.7	27,223	655	9,316	0.66	6.36	32	1.60	0.1	<2.14	3.74	2504	0.29	631.1	<0.2	10.7	2041.7	<5	10.2
OW 33	7.0	16,788	639	4,875	<0.5	3.82	59	2.28	<0.09	<2.14	3.33	2788	0.32	339.4	<0.2	4.6	2422.3	<5	29.4
OW 34	7.6	949	288	54	<0.5	0.04	24	0.39	<0.09	<2.14	1.99	17	0.19	7.4	<0.2	0.5	47.9	<5	6.7
OW 35	7.1	3,736	513	758	0.67	0.72	39	1.11	<0.09	<2.14	2.70	298	0.23	26.2	<0.2	3.7	142.3	<5	29.2

OW Ref.	pH	Conductivity	Total Alk.	Cl	Fl	Soda	Al	As	Cd	Cr	Cu	Fe	Pb	Mg	Hg	Ni	SO4	Ti	Zn
		mS/cm	mg/l CaCO3	mg/l	mg/l	g/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	µg/l	µg/l	mg/l SO4	µg/l	µg/l
OW 36	7.1	11,087	499	3,534	<0.5	2.35	47	0.96	<0.09	<2.14	2.47	222	0.18	289.9	<0.2	6.9	405.4	<5	73.4
OW 37	7.3	806	331	38	<0.5	0.02	14	0.45	<0.09	<2.14	1.23	118	0.17	16.5	<0.2	0.5	23.4	<5	4.3
OW 38	7.4	707	210	31	<0.5	0.02	26	0.64	<0.09	<0.93	1.38	167	0.56	4.8	<0.2	0.7	29.6	<5	3.0
OW 39	7.3	1,044	222	22	<0.5	0.02	36	0.45	<0.09	<0.93	1.18	101	0.61	19.4	<0.2	1.1	260.1	<5	4.4
OW 40	7.6	623	199	45	<0.5	0.03	77	0.54	<0.09	<0.93	0.96	120	2.35	9.9	<0.2	1.0	28.9	<5	6.0
OW 41	7.5	689	222	41	<0.5	0.02	44	0.34	<0.09	<2.14	1.63	76	0.23	11.0	<0.04	0.4	17.8	<5	3.3
OW 42	7.3	762	248	33	<0.5	0.02	58	0.37	<0.09	<2.14	1.91	92	0.20	6.1	<0.04	0.4	10.1	<5	2.9
OW 43	7.6	3,249	214	898	<0.5	0.51	50	0.41	<0.09	<2.14	1.31	39	0.28	62.1	<0.04	0.5	106.6	<5	4.2
OW 44	7.2	865	314	42	<0.5	0.04	39	0.40	<0.09	<0.93	1.30	63	0.33	12.1	<0.2	0.7	31.1	<5	4.9
OW 45	7.1	1,190	283	61	<0.5	0.08	589	0.83	<0.09	<2.14	2.12	282	1.69875	17.1	<0.2	1.1	105.0	<5	101.6

Alk. = Alkalinity  
Cl = Chloride  
Fl = Fluoride

\* OW7, 8, 16, 17, 18, 19, 23 were decommissioned in 2010 due to BRDA expansion

### 8.3 Leak Detection Monitoring System

In accordance with Schedule C.8 of the IPPC Licence and Condition 6.20, AAL is required to undertake bi-annual groundwater monitoring for hydrocarbon in four monitoring boreholes (BH1- BH4) located in the former underground fuel storage area.

The fuel storage area comprised three steel underground storage tanks (UST's), two of which were used for diesel and one for petrol. The two diesel UST's were decommissioned after Agency approval in 2005.

Low levels of DRO and PAH were detected in groundwater samples taken during 2010. This was believed to be related to historic leaks prior to the decommissioning of the UST's. AAL commenced an in situ remediation programme in late 2010 involving the application of an oxygen release compound (calcium oxyhydroxide) which biodegrades the hydrocarbons.

The results of groundwater monitoring carried out in May and December 2012 are tabulated in Table 36 below.

**Table 36 Borehole Groundwater Monitoring Results 2012**

Borehole Ref.	Date	DRO* (µg/l)	PAH* (µg/l)
BH 1	28/05/12	2004	<0.1
	10/12/12	406	<0.1
BH 2	28/05/12	12,354	<0.1
	10/12/12	129,331	<0.1
BH 3	28/05/12	220	<0.1
	10/12/12	1,372	<0.1
BH 4	28/05/12	167	<0.1
	10/12/12	832	<0.1

\*DRO – Diesel Range Organic hydrocarbons; PAH - Polycyclic Aromatic Hydrocarbons.

The UST accounting for the elevated DRO in BH2 is decommissioned. This is residual diesel and will reduce over time.

### 8.4 Fugitive Emissions in the AAL Plant Area

AAL undertakes monitoring for fugitive dust emissions at twenty eight locations within the site perimeter.

The dust deposition gauges (labelled DG 1–28) measure deposited particulate material, collected over a 30-day period in accordance with TA Luft/VDI Guidelines 2119 Part 2. In total, there are 19 deposition gauges located around the BRDA to monitor dusting from the landfill area including the Phase 2 BRDA (DG 4–13, 20–28).

Dust deposition measures the daily quantity of dust settling over a specified area (m<sup>2</sup>) and is expressed as milligrams per square metre per day (mg/m<sup>2</sup>/day).

Average results for 2012 are summarised in Table 38. Results are presented as mean annual rates for each location, together with the range of monthly data recorded throughout the year.

Deposition rates were generally low (<100mg/m<sup>2</sup>/day) and Enterprise Ireland suggests that average levels between 30 – 100 mg/m<sup>2</sup>/day are typical of small towns and light industrial areas and as such are ‘hardly noticeable’.

**Table 37 Dust Deposition Rates (mg/m<sup>2</sup>/day) in 2012**

Deposition Gauge No.	Average Deposition Rate (mg/m <sup>2</sup> /day)	Range (Min - Max) (mg/m <sup>2</sup> /day)	TA Luft Guideline Limit mg/m <sup>2</sup> /day
D.G. 1	43	12 - 78	350
D.G. 2	45	3 - 95	350
D.G. 3	23	3 - 48	350
D.G. 4	45	2 - 128	350
D.G. 5	22	2 - 70	350
D.G. 6	18	2 - 77	350
D.G. 7	39	3 - 146	350
D.G. 8	38	6 - 123	350
D.G. 9	25	0 - 104	350
D.G. 10	19	4 - 42	350
D.G. 11	22	3 - 58	350
D.G. 12	35	4 - 105	350
D.G. 13	29	5 - 87	350
D.G. 14	8	1 - 20	350
D.G. 15	20	5 - 80	350
D.G. 16	15	2 - 74	350
D.G. 17	28	12 - 46	350
D.G. 18	49	13 - 106	350
D.G. 19	110	28 - 324	350
D.G. 20	17	5 - 34	350
D.G. 21	37	1 - 241	350
D.G. 22	23	1 - 100	350
D.G. 23	19	1 - 103	350
D.G. 24	25	4 - 63	350
D.G. 25	27	3 - 102	350
D.G. 26	24	2 - 82	350
D.G. 27	18	1 - 52	350
D.G. 28	20	4 - 78	350

DG19 is located near the alumina silos and outdoor hydrate storage area.

## 8.5 Ambient Air Quality Monitoring

A programme of ambient air quality monitoring (both on-site and off-site) is carried out by AAL in accordance with Conditions 5.8 and 6.18 of the IPPC Licence.

The parameters monitored as part of the ambient air quality monitoring programme are:

- Sulphur dioxide
- Deposited Dust
- Particulate Matter below 10µm (PM<sub>10</sub>)
- Particulate Matter below 2.5 µm (PM<sub>2.5</sub>)

All results from the ambient air quality monitoring programme are reviewed versus the relevant limits and thresholds of the Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive 2008/50/EC as transposed into Irish legislation by the Air Quality Standard Regulations 2011 (SI 180/2011). Overall, the results of the monitoring indicate the ambient air quality in the area is good, with the various values falling within the relevant targets for those parameters.

### 8.5.1 Ambient Air Sulphur Dioxide Monitoring

Sulphur dioxide (SO<sub>2</sub>) is monitored as part of the ambient air quality monitoring programme via two continuous active SO<sub>2</sub> monitors located at Foynes and Ballysteen, along with passive diffusion tubes placed at 9 locations (including co-location with the continuous monitors).

**Table 38 Ambient Air Sulphur Dioxide Continuous Monitoring Results (µg/m<sup>3</sup>)**

Continuous SO <sub>2</sub> Monitors	SO <sub>2</sub> Monitoring Location		CAFE Limits (µg/m <sup>3</sup> )	Basis of Application of Limit Value
	Foynes	Ballysteen		
Max Hourly Value (µg/m <sup>3</sup> )	76.1	67.6	350	Not to be exceeded more than 24 times in a calendar year
Max Daily Average (µg/m <sup>3</sup> )	20.2	12.2	125	Not to be exceeded more than 3 times in a calendar year
Winter Mean (µg/m <sup>3</sup> )	6.8	4.4	20	1 <sup>st</sup> October to 31 <sup>st</sup> March
# Daily Averages >50µg/m <sup>3</sup>	0	0	50	Lower Assessment Threshold: 40% of 24-hour limit, not to be exceeded more than 3 times in a calendar year

A summary of the ambient sulphur dioxide diffusion tubes results are tabulated below in Table 40, along with a description of their locations.

**Table 39 Ambient Air Sulphur Dioxide Diffusion Tubes Monthly Results ( $\mu\text{g}/\text{m}^3$ )**

Monitoring Location	Annual Mean ( $\mu\text{g}/\text{m}^3$ )	Min Result ( $\mu\text{g}/\text{m}^3$ )	Max Result ( $\mu\text{g}/\text{m}^3$ )	CAFE Lower Assessment Threshold
Kenricks House (Site #1)	1.0	0.6	1.8	<50 $\mu\text{g}/\text{m}^3$ (Not to be exceeded more than 3 times per year)
Kenricks House (1A)	1.5	0.8	3.8	
Raw Water Intake (2)	1.8	0.9	5.5	
Keane's House (3)	1.1	0.9	1.8	
Water Works (4)	0.9	0.7	2.0	
Foynes (5)	1.7	0.8	4.0	
Moran's House (6)	2.3	2.0	6.0	
Fitzsimon's House (7)	1.3	1.1	2.2	
Aughinish (8)	1.3	0.9	2.9	
Foynes Reservoir (9)	1.5	0.4	4.5	
Foynes Reservoir (9A)	1.2	0.8	3.0	

\*CAFE threshold shown is lower assessment threshold for SO<sub>2</sub> (40% of 24-hour limit value)

### 8.5.2 Ambient Air Particulate Deposition

Particulate deposition is monitored at 2 off-site locations as part of the ambient air quality monitoring programme. Table 41 below shows a summary of the results for these monitoring locations during 2012.

**Table 40 Ambient Air Mean Monthly Particulate Deposition Rates ( $\text{mg}/\text{m}^2/\text{day}$ )**

Site No.	Location	Deposition Rate ( $\text{mg}/\text{m}^2/\text{day}$ )	Range ( $\text{mg}/\text{m}^2/\text{day}$ )
3	Keane's House	23	4 - 46
7	Fitzsimons House	26	2 - 62

### 8.5.3 Ambient Air PM<sub>10</sub> Monitoring

Particulate matter below 10 $\mu\text{m}$  (PM<sub>10</sub>) is monitored by AAL at 3 locations (1 onsite & 2 offsite) using Partisol Model 2025 Air Samplers. Filters for all monitors are weighed at an external accredited laboratory. Table 42 below shows a summary of the results obtained for PM<sub>10</sub> monitoring during 2012.

**Table 41 Ambient Air Daily PM<sub>10</sub> Monitoring Results 2012**

	PM <sub>10</sub> Monitoring Location			CAFE Limits (µg/m <sup>3</sup> )	Basis of Application of Limit Value
	Foynes	Ballysteen	NE of Plant		
Annual Mean µg/m <sup>3</sup>	7.2	6.6	17.9	40 µg/m <sup>3</sup>	-
Max Daily Value µg/m <sup>3</sup>	49.6	30.6	55.9	50 µg/m <sup>3</sup>	Not to be exceeded more than 35 times in a calendar year
# Daily Values >50µg/m <sup>3</sup>	0	0	2	50 µg/m <sup>3</sup>	Not to be exceeded more than 35 times in a calendar year

All Partisol filters are further analysed, following weighing, to determine the sodium content of the particulate matter collected. A summary of the annual means and range sodium concentrations obtained for all three sampling locations is shown below in Table 43.

**Table 42 Ambient Air Daily Sodium Monitoring Results 2012**

	Sampling Location		
	Foynes	Ballysteen	NE of Plant
Average Daily Na Content (µg/m <sup>3</sup> )	4.1	4.1	4.2
Max Daily Na Content (µg/m <sup>3</sup> )	33.3	11.1	25.4

#### 8.5.4 Ambient Air PM<sub>2.5</sub> Monitoring

Monitoring of particulate matter below 2.5µm (PM<sub>2.5</sub>) is carried out at 5 locations (2 on-site and 3 off-site) by AAL. The monitoring is carried out using Osiris Air Sampling Monitors and Table 44 below shows a summary of the results obtained for the 2012 monitoring.

**Table 43 Ambient Air Daily PM<sub>2.5</sub> Monitoring Results 2012 (µg/m<sup>3</sup>)**

PM <sub>2.5</sub> Monitoring Location	NE of Plant	LCC WTP	SW of Plant	Foynes	Ballysteen	CAFE Directive Limits
Annual Mean	5.7	2.5	3.4	4.8	4.1	25 µg/m <sup>3</sup>
Max Value	46.3	31.5	60.1	43.0	69.6	-
90%tile	10.8	6.3	7.3	9.7	8.6	-

## **8.6 Bund, Tank and Pipeline Integrity Testing**

Condition 6 of the IPPC Licence (Control and Monitoring) states the requirements for the protection of groundwater from spills, leaks and improper storage. Specifically, Condition 6.10 deals with the inspection and testing of bunding structures, tanks and underground pipelines.

### **8.6.1 Bunds and Tanks**

The site has a number of integrity testing and repair programmes.

The integrity testing of all bunding structures and tanks is carried out on an on-going three-year cycle. In total, there are 330 separate items requiring integrity testing at AAL and in 2012 the integrity of 77 items was confirmed.

In the past few years substantial sections of the drainage network have been upgraded with a steel or stainless steel liner to minimise the risk of groundwater contamination.

### **8.6.2 Underground Pipelines**

All pipelines carrying process effluent are above-ground.

All non-process effluent pipelines (sanitary) were re-tested in 2010 in accordance with IPPC Licence Condition 6.10. A number of minor repairs were identified and these have been completed. The pipelines will be tested again in 2013.

## **8.7 Decommissioning and Residuals Management Plan (DRMP/CRAMP) Review**

Condition 10 of the IPPC Licence requires that AAL shall continue to maintain a fully detailed and costed Decommissioning and Residuals Management Plan (DRMP), which is adequate to assure the Agency that AAL is at all times capable of financing the environmental decommissioning and restoration of the AAL site at closure. The plan must be reviewed annually.

### **8.7.1 Update of CRAMP**

In 2010, the DRMP was revised to form a CRAMP (Closure Restoration and Aftercare Management Plan) in accordance with the 2006 EPA Document: Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision and further guidance and instruction from the Agency. The total cost of closure, restoration and aftercare of the entire facility which includes for long-term management and monitoring over a 30-year period was estimated at €20,393,853 in 2010, which was updated for inflation in 2011 to €21,015,171.

In 2012, AAL constructed a trial wetlands effluent treatment area which will be assessed in the coming years to determine its suitability to form part of the CRAMP.

### **8.7.2 Update of CRAMP Costs**

The projected closure, restoration and aftercare costs for 2012, based on the Wholesale Price Index, Capital Goods; Materials and Wages (as published by the Central Statistic Office for year 2012) January 2012 to December 2012, is calculated below:

$$€21,015,171 \times 112.5/111.6 = €21,183,292$$

### **8.7.3 Financial Provision**

In July 2011, AAL proposed to the Agency that it will commence to set aside €2 million per annum into a secure fund by means of an Agency designated deposit account from 2014. This will ensure that adequate closure funds will be in place and under Agency control by 2025 and will ensure compliance with IPPCL Condition 12.2.1.

At present the funding is guaranteed by a Parent Company Guarantee from our owners UC Rusal. The structure of the underwriting for this activity is such that it allows for escalations based on changes to the scope or to the Wholesale Price Index (WPI).

## **8.8 Environmental Liabilities Risk Assessment (ELRA) Review**

In accordance with Condition 12.7.2 of the IPPC Licence, AAL is required to engage an independent consultant to complete a comprehensive and fully costed Environmental Liabilities Risk Assessment (ELRA), at least every three years. The ELRA must address the liabilities from past and present activities on-site and must include those liabilities and costs identified in Condition 10 for execution of the CRAMP.

The ELRA shall be reviewed as necessary to reflect any significant changes on site. Under Condition 12.7.3, AAL is also required to have adequate financial provision in place to cover the identified liabilities in the event of occurrence.

### **8.8.1 Update of ELRA**

In 2010, a revised ELRA was conducted by AAL's consultants PM Group. The assessment identified no medium or high level risks. All risks were in the green low level range. The cost, calculated in accordance with the EPA Guidance, for unknown liabilities associated with the operational and closure phases of the AAL facility was calculated at €2,804,700.

The ELRA will be reviewed in 2013 in line with the updated guidance from the Agency, when issued.

### **8.8.2 Update of ELRA Costs**

The figure is updated annually based on the Wholesale Price Index, Capital Goods; Materials and Wages (as published by the Central Statistic Office). In 2011 the original figure was updated to €2,890,148.

The updated figure for 2012 was calculated as follows:

$$€2,890,148 \times 112.5/111.6 = €2,913,269$$

### **8.8.3 Financial Provision**

AAL has General Liability Insurance which provides environmental insurance cover to a level significantly greater than the figure above. Details have previously been submitted to the Agency.

### **8.8.4 Statement of Measures in Relation to Prevention of Environmental Damage**

The measures currently undertaken by AAL in relation to the prevention of environmental damage and possible remedial actions were detailed in the revised CRAMP and ELRA submitted to the EPA during 2010.

### **8.8.5 Report on consultation with the Local authority & the Principal Response Agencies in relation to Emergency Planning for the BRDA**

During 2012, RUSAL Aughinish consulted with and met representatives of Limerick County Council (LCC) (Fire Service & Environment Dept) and the Health Service Executive (HSE) with a view to the preparation of an External Emergency Plan for the BRDA. The consultation process consisted of written and verbal communication with LCC, a site inspection by LCC and the HSE on 17th October 2012 and submission of documentation to LCC to assist the preparation of the External Emergency Plan. The documentation submitted included the Aughinish Internal Emergency Response Plan, BRDA emergency procedures, a Risk Assessment and Breakout Study for the BRDA, maps, drawings etc. A newspaper notice was published by LCC on the 24th January 2013 notifying the public that the process of drafting the External Emergency Plan had commenced.

## 8.9 Annual Landfill (BRDA) Status Report

Operational information required under Schedule D of the IPPC Licence in respect of the Bauxite Residue Disposal Area (BRDA) is tabulated In Table 45 below. There are no closed areas within the BRDA and all areas are currently operational.

**Table 44 BRDA Operational Status**

Parameter	Details
Landfill name & Licence number	Aughinish Alumina Ltd. (BRDA) IPPCL Reg. P0035-05
Landfill location	Aughinish Island (National Grid Ref. 127300E, 152200N)
Reporting period	Jan 01 – Dec 31 2012
Owner and/or operator	Aughinish Alumina Ltd.
Area occupied by waste	168.5 hectares (94.5 ha Phase 1 BRDA, 74 ha Phase 2 BRDA)
Tonnage and composition of waste deposited in the preceding year	1,303,383 tonnes (See Table 46)
Methods of depositing	Pumping/Trucking
Time and duration of depositing	24 hours per day, 365 days per year
Total accumulated quantities of waste deposited	24,061,439 tonnes (Table 47)
Calculated remaining capacity	25,606,117 tonnes (Table 48)
Calculated final capacity of site	49,667,556 tonnes
Year in which final capacity of site is expected to be reached	2031
Stability checks undertaken	See Section 8.9.3
Results of monitoring programme	See Section 8.9.3
Summary of any monitoring non-compliances and corrective actions taken	No non-compliances in 2012
Summary of any development/remedial works carried out in the preceding year	See Section 8.9.5
Revisions to Landfill Operational Plan	See Attachment 6
Progress on restoration of completed cells	Not Applicable

### 8.9.1 BRDA Waste Composition and Tonnage Data

Information on current and projected waste disposal rates, together with a breakdown of waste types is tabulated below.

**Table 45 BRDA Waste Composition & Tonnage 2012**

Waste Stream	EWC Code	Jan – Dec 2012 Total (t)	As % of total waste landfilled
Fluestack Residues (dry)	16 11 04	83	0.01%
Lime Grits/Stone (wet)	01 03 99	5,590	0.43%
Sand (wet)	01 03 99	81,835	6.28%
Process Waste (wet)	01 03 99	16,709	1.28%
Red Mud (dry)	01 03 09	1,183,358	90.79%
Salt Cake (wet)	01 03 07	15,808	1.21%
<b>Total Waste</b>		<b>1,303,383</b>	<b>100.00%</b>

**Table 46 Accumulated Quantities of Waste to BRDA 1983 to Dec 2012**

Waste Stream	EWC Code	1983 – Dec 2012	As % of total waste landfilled
Effluent Sludge A34 Clarifier (dry)*	06 05 03	4,380	0.02%
Fluestack Residues (dry)	16 11 04	4,489	0.02%
Lime Grits (wet)	01 03 99	122,186	0.51%
Process Waste (wet) (incl. Sand)	01 03 99	2,230,543	9.27%
Red Mud (dry)	01 03 09	21,338,072	88.68%
Salt Cake (wet)	01 03 07	361,769	1.50%
<b>Total Waste</b>		<b>24,061,439</b>	<b>100%</b>

(Note1: The data for all residues for 1983 - 1997 other than red mud are estimated based on pro-rata tonnages for the period 1997 to 2000)

\* Material no longer generated at plant.

Engineering estimates of the total occupied and remaining capacity of the BRDA have been updated to reflect recorded quantities of waste deposited at the facility during 2012 and take into account the residue deposited in both the Phase 1 BRDA and the Phase 2 BRDA commissioned since 2011 and are tabulated overleaf.

**Table 47 Estimated Capacity of BRDA**

Period	MOM Note 1	Waste during period (t)	Accumulated waste (t)	Remaining capacity of BRDA (t)
1983- 2000	R	9,952,703	9,952,703	9,762,404
2001	R	1,110,916	11,063,619	8,651,488
2002	R	1,111,886	12,175,505	7,539,602
2003	R	1,053,818	13,229,323	6,485,784
2004	R	1,077,940	14,307,263	5,407,844
2005	R	1,224,053	15,531,316	4,183,791
2006	R	1,270,270	16,801,586	2,913,520
2007	R	1,221,369	18,022,955	1,692,151
2008	R	1,240,695	19,263,651	451,455
2009	R	994,993	20,165,917	3,213,230 <sup>Note 2</sup>
2010	R	1,251,060	21,416,978	1,962,170
2011	R	1,341,079	22,758,056	26,909,500 <sup>Note 3</sup>
2012	R	1,303,383	24,061,439	25,606,117
2013	E	1,338,933	25,400,372	24,267,184

<sup>1</sup> MOM – Method of Measurement; R = Recorded (Measured); E = Engineering Estimate

<sup>2</sup> Increase in capacity of Phase 1 BRDA with increase in height to 32 meters (i.e. going from Stage 7 perimeter lift to Stage 10 perimeter lift) following issue of IPPCL P0035-04 in 2008.

<sup>3</sup> Phase 2 BRDA was commissioned in Aug 2011 increasing the overall capacity from 31<sup>st</sup> Dec 2011 onwards.

### 8.9.2 BRDA Containment Capacity

Containment capacity within the BRDA is developed by the construction of rock fill terrace embankments around the BRDA perimeter. These embankments are constructed in stages, each stage increasing the elevation of the BRDA by 2 metres. For the Phase 1 BRDA approximately 4% of the Phase 1 BRDA perimeter is currently at Stage 10, 49% of the BRDA perimeter is currently at Stage 9, 41% is at Stage 8 and 6% is at Stage 7. All mud filling in the Phase 2 BRDA has yet to fill up to the top of the inner wall, i.e. Stage 0. The current IPPC Licence and planning permission permits the entire existing Phase 1 and Phase 2 BRDA perimeters to be raised to Stage 10.

This will extend the lifetime of the existing BRDA to mid-year 2031 at current licensed production rates.

### **8.9.3 Results of BRDA Monitoring Programme**

The 2012 Report on the BRDA monitoring programme is reported in the Golder 2012 Annual (Stability) Review submitted via ALDER. The executive summary of the Golder report can be found in Section 8.9.8.

Monitoring of environmental conditions at the BRDA is undertaken on a routine basis through the collection of samples of groundwater from observation wells (OW's) and surface waters for analysis. Monitoring results for the 2012 reporting period are detailed in Section 2.2.7 (Surface Waters) and 8.2.3 (Groundwater) of this AER.

There are 28 dust deposition gauges at various locations around the perimeter of the BRDA to determine the rates of dusting from the BRDA. Monitoring results for the 2012 reporting period have been detailed in Section 8.4 (Fugitive Emissions in the AAL Plant Area).

### **8.9.4 Revisions to BRDA Operational Plan**

The BRDA Operational Plan has been updated to detail construction works which were completed in the BRDA in 2012 and is appended as Attachment 6.

### **8.9.5 Summary of BRDA Development/Remedial Works 2012**

The Storm Water Pond and the Liquid Waste Pond were raised by 1.3 metres in 2012. This delivered additional storage capacity for storm water and for treated process effluent respectively to reflect the additional catchment area of the Phase 2 BRDA. A pumping facility was installed to pump storm water from the Phase 2 BRDA to the Phase 1 BRDA. The civil works for the Salt Cake cell were undertaken in the last quarter of 2012 and the entire composite lining system was leak tested in accordance with the CQA Plan. The mechanical and electrical works for the leachate collection system for the new salt cake cell were progressed by year end 2012.

The development of the residue carbonation via on-site testing and development works continued during 2012 to confirm the range of mud layer thickness and time periods as well as machinery requirements to achieve the optimum reduction in residue causticity. A report on this 'Residue Neutralisation' work is being prepared for submission in April 2013.

### **8.9.6 Progress on Closure Planning & Re-vegetation of BRDA**

IPPC Licence Condition 8.4.17 requires that AAL continues to strive to implement the recommendations in the relevant sub-sections of the Residues Solutions Report submitted to the Agency in July 2007. The subsections to be addressed are:

- Closure Planning
- Closure Re-vegetation
- Post-Closure Management
- Alternative Uses of Residue

For the last number of years AAL, in conjunction with the University of Limerick, has been carrying out an extensive research programme with the specific aim of

developing the knowledge required for the closure and successful revegetation of the BRDA. This research programme has been carried out both on and off site by AAL personnel and contracted researchers.

A progress report is included as Attachment 7.

### **8.9.7 BRDA Events 2012**

The following events relating to the BRDA are relevant:

- The full CQA Validation Report compiled by Golder Associates for the Phase 2 BRDA was issued to the Agency in February 2012
- The contract to raise the Storm Water Pond and Liquid Waste Pond by 1.3 metres was implemented by Murphy International Ltd under the supervision of Golder Associates in the period April to July 2012.
- The completed CQA Validation Report for the SWP and LWP raise was issued in October 2012.
- The composite lining element for construction of the new Salt Cake Cell within the BRDA was completed by Priority Construction Ltd under the supervision of Golder Associates in the period September to December 2012. The remaining civil works and mechanical and electrical works associated with the project will be completed by February 2013
- A permanent pumping facility to transfer water from the Phase 2 BRDA Perimeter Channel to the Phase 1 BRDA Perimeter Channel was commissioned in June 2012
- 60% of the dusting prevention sprinkler system within the Phase 1 BRDA was upgraded in the period June to August 2012 to the same standard as the Phase 2 BRDA sprinkler system. The balance will be upgraded by end April 2013.
- The upstream side (i.e. landside) of the headwall for the south west sluice gate to the Robertstown River was sealed permanently closed in July 2012. Therefore the drainage network from all the lands between the BRDA and the Shannon/Robertstown River now enters the Robertstown River through a single discharge at the existing North West sluice gate. This facilitates routine monitoring and in the unlikely event of a BRDA containment failure it will facilitate isolation of the drainage system from the Robertstown River.
- The development of the residue neutralisation process via on-site testing and development works continued during 2012 to confirm the range of mud layer thickness and time periods as well as machinery requirements to achieve the optimum reduction in residue causticity
- There were no significant incidents as per Condition 9.5 or reportable incidents as per Condition 11.2 within the BRDA during 2012.

### **8.9.8 Report on Annual BRDA Review**

Golder Associates were commissioned by AAL to prepare a report to facilitate licensee compliance with Appendix C7 of IPPC License P0035-05 namely 'the annual review' for the Bauxite Residue Disposal Area (BRDA). This section comprises the executive summary of the Golder's report and the full report will be submitted to the Agency via the ALDER system.

The stability assessment summarises the monitoring results from the Casagrande piezometers, the vibrating wire piezometers and inclinometers / extensometers and visual inspection of the facilities and assesses the stability of

the BRDA, the inner and outer perimeter walls forming the perimeter interceptor channel, the storm water and liquid waste ponds.

The Phase 1 BRDA is formed from two facilities, the original Phase 1 BRDA, covering an area of 72 ha and the Phase 1 BRDA extension covering an area of 32 ha. The Phase 1 extension is lined with a HDPE geomembrane while the original Phase 1 relies on the low permeability of the estuarine soils to minimise seepage from the base of the facility, plus the inherent low permeability of the red mud itself. Phase 2 BRDA covers an area of 80 Ha and was commissioned in 2011 and is currently receiving the majority of the red mud generated.

The initial design for the Phase 1 BRDA facility was to provide storage to the year 2009 based on the facility constructed to Stage 7 (elevation 18 m AMSL), which equates to a central elevation of 27.5 m AMSL or 26 m above original ground level. A site investigation and design report was presented to AAL (References 2.1 to 2.4) proposing to raise the facility in three more stages (Stages 8, 9 and 10), resulting in a maximum perimeter elevation of 24 m and a central elevation of 32 m AMSL.

AAL have successfully raised the stack wall to Stage 8 and in certain sections to Stage 9.

The key components of the BRDA are:

- Low Permeability Outer Perimeter Embankment Wall;
- Permeable Inner Perimeter Embankment Wall;
- Perimeter Interceptor Channel;
- Composite Lined System Throughout the Phase 1 Extension and Phase 2 BRDA;
- Stage Raises; and
- Upper level bench to reduce the overall side slopes from 6H:1V to 6.3H:1V.

The Phase 1 and the new Phase 2 BRDA are surrounded by a perimeter interceptor channel which is formed by constructing the outer and inner perimeter embankment walls. Surface water collected in the perimeter interceptor channel is pumped back to the plant or into the storm water pond during storm events. The Phase 1 and Phase 2 channels connect on the western section of the facilities. The Phase 1 and Phase 2 facilities will also be merged in the future.

Treated effluent is pumped from the Area 34 Annex effluent treatment facility and into the liquid waste pond prior to discharge into the River Shannon.

Unlike conventional tailings facilities or water retaining dams, the BRDA retains little to no surface water on the red mud. The red mud is discharged as a paste from several near central discharge points to form a dome which typically has the apex some 6m to 8m above the perimeter stack wall elevation. The structure is raised by constructing perimeter walls on the red mud by the upstream method which involves the construction of a series of retaining bunds upstream of the toe of the BRDA facility and so forming a supporting face to the overall structure.

The final elevation of the perimeter stack wall will be 24 m AMSL and the highest elevation of stacked residue will be 32 m AMSL, or some 30 m above ground level.

From the results of the monitoring of the inclinometers, extensometers and piezometers together with the 2010 CPT testing, it is apparent that the stack wall

of the BRDA is stable at the current elevations and the facility is performing in accordance with the design.

The outer and inner perimeter walls, the storm water and liquid waste ponds are performing in accordance with the design.

Visual inspection of the facilities indicates no signs of distress in the walls.

Golders Associates consider that the Continuous Penetration Testing (CPT) and laboratory testing should be undertaken during 2013 in the red mud at stage 9, and six new piezometers and four inclinometers should be installed into the stack wall. For the purpose of the future annual audits, Golders also recommend that eight new piezometers should be installed in the estuarine foundation soils beneath the outer perimeter wall and the storm water pond.

Where seepages emanating from the Phase 1 BRDA perimeter interceptor channel are intercepted, the flow rate should be monitored to determine any changes in flow rate.

The volume of any red mud retained in the perimeter interceptor channel should be estimated and checked against design calculations to ensure sufficient flood storage is available and the freeboard can be maintained. The red mud has the ability to throttle seepage emanating from defects in the geomembrane forming the lining system in the perimeter interceptor channel.

Spillways and /or overflow pipes should be considered to connect the Phase 2 BRDA perimeter interceptor channel to the Phase 1 BRDA perimeter interceptor channel and certainly should be installed at closure. Currently water in the Phase 2 BRDA is pumped into the Phase 1 BRDA. It is understood that AAL are going to install two additional submersible pump adjacent to the sump area which pumps the Phase 1 PIC back to the effluent treatment plant. These two new pumps will be solely dedicated to pumping from the Phase 1 PIC to the SWP. As the existing large PIC pump has a valve tee connection to facilitate filling of the Storm Water Pond, these two new dedicated pumps give a large measure of equipment flexibility to discharge water from the PIC to the SWP.

AAL have their own power generating station providing a very reliable supply to the plant and ancillary structures such as the pumps servicing the PIC, SWP and LWP. Electricians provide 24 hour coverage for emergencies resulting from electrical outages or breakdowns.

#### **8.9.9 Progress with Implementation of Golders Breakout Study**

A complete revision of the Golder Associates BRDA Risk Assessment and Breakout Study was submitted to the Agency in March 2013 (refer also to Section 8.8.5).

The majority of the recommendations in the most recent report are already being implemented and a detailed progress report will be submitted to the Agency in due course as per the timescale in Condition 8.4.16.

The contract to install the gabion mattress along the downstream walls of the north and west sides of the Phase 1 BRDA and the west wall of the Phase 2 BRDA has been awarded to InterGeo Ltd for implementation during Quarters 2 and 3 of 2013.

#### **8.9.10 Biennial Audit at the BRDA**

AAL has submitted to the Agency a proposal outlining the scope of the biennial audit and the frequency of the equivalent Safety Evaluation of Existing Dams (SEED) audit to be undertaken at the BRDA.

### **8.9.11 Report on Implementation of Extractive Waste Management Plan**

RUSAL Aughinish is required under Condition 8.3.1 of the revised IPPC Licence P0035-05 to draw up an Extractive Waste Management Plan for the minimisation, treatment, recovery & disposal of extractive waste in accordance with Regulation 5 of the Waste Management (Management of Waste from Extractive Industries).

## **8.10 Progress on Bauxite Residue Neutralisation**

In 2008, Aughinish Alumina received an updated IPPC licence (P0035-04) which required a study to be undertaken into the feasibility to neutralise or partially neutralise red mud residue. During 2008-2011 studies at the University of Limerick into mud neutralisation concluded that enhanced atmospheric carbonation during mud farming presented the only feasible means of mud partial neutralisation at Aughinish without undermining the environmentally sound dry disposal method employed at the Aughinish BRDA. This conclusion was acknowledged by the EPA and is reflected in the current IPPC licence P0035-05 (October 2012) where Aughinish Alumina is required to implement neutralisation of bauxite residue to the 'best practicable level' and preferably via atmospheric carbonation employing mud farming (Conditions 8.4.18/19).

During 2012 mud farming development trials were conducted in BRDA Phase 1 to identify the most suitable tractors, ploughs and re-compaction equipment to undertake enhanced carbonation through mud farming on a full industrial scale. The trials were deemed successful with pH reduction from ~13 in fresh mud to below 11.5. During 2013 the process of industrial mud farming will be implemented in BRDA Phase 1 and gradually in BRDA Phase 2 as the Phase 2 area is commissioned with a protective mud layer above the synthetic liner.

Based on the mud farming trials in 2012 the following outlines how partial neutralisation of red mud via enhanced atmospheric carbonation will be implemented at Aughinish.

Red mud residue from the Aughinish Alumina Bayer process for alumina extraction undergoes water washing and vacuum filtration prior to re-pulping and pumping as a thick paste to the Bauxite Residue Disposal Area (BRDA) for deposition and drying. The combined BRDA area is effectively a large mono-cell and will be divided into 50 operational areas or cells to facilitate short discharge times and thin layer deposition. Red mud will be deposited in one cell at a time to a layer depth of approximately 0.4m. When a mud cell has been filled during 2 -3 days of operation the fresh mud discharge will move to a new cell. After a period of 7-14 days the cell which has been filled with red mud will be 'amphirolled' to express residual water from the mud and to aid its compaction. Following 10-15 passes of an amphiroll over a 2-4 month period the mud will reach a steady state compaction level. The typical solids concentration will have increased from 58% up to >70% during this Amphirolling period. This is the most important and time-consuming step in mud farming.

Following Amphirolling the mud cell will be levelled and graded using a tracked bucket excavator to leave the cell ready for aeration and carbonation through

ploughing and harrowing. At this point the causticity of the entrained water is typically 70% (i.e. 70% of the soda is present as caustic and the balance is present as sodium carbonate) and the pH is typically 12. By continually exposing red mud and its associated dilute caustic to the CO<sub>2</sub> contained in the atmosphere the entrained sodium hydroxide in the mud will convert gradually to sodium carbonate and the pH will reduce. Over the course of approximately 20 passes of the plough/harrow the caustic will gradually carbonate and the pH will reduce to below 11.5. The benefit of reducing causticity and pH is that the mud becomes less corrosive to human tissue and so is less hazardous. At pH below 11.5 it is expected that there will be no corrosive effect on human skin tissue and thus pH 11.5 is considered a benchmark for mud neutralisation.

After partial neutralisation the mud will be re-compacted by means of a vibrating roller to leave the cell ready for the sequence to recommence with deposition of fresh mud. In theory the cycle time available is 120 days between subsequent deposition cycles of fresh mud in a given mud cell.

This new technology of enhanced atmospheric carbonation is being developed at Rusal Aughinish Alumina. It presents a significant challenge given:

- The slime nature of red mud (d<sub>50</sub> <5 microns) which makes the mud difficult to de-water and difficult to work until it has been adequately de-watered
- The quantity of mud to be processed annually (~1.2 million tonnes per annum dry basis)
- The Irish weather (extended periods of low rainfall with minimal net evaporation)

As a consequence it will be difficult to implement the full mud farming cycle during the wet winter months when net evaporation (evaporation-rainfall) is negative. However, the greater the area available for mud deposition and drying, the greater the cycle time available within which to neutralise the mud.

At present BRDA Phase 1 with an active area of 55 hectares is almost full while BRDA Phase 2 with an active area of 78 hectares has only recently commenced operation. Once BRDA Phase 1 is exhausted the active drying and carbonation area will reduce by 40% and mud farming logistics will become even more difficult. For this reason we are considering the feasibility to extend the life-time of BRDA Phase 1 by increasing the permitted height by 3 more stage lifts. This issue will be addressed at the end of 2013 when full scale mud farming has been implemented and when BRDA Phase 1 side slopes have been re-vegetated as part of the interim closure works on Phase 1.

### **8.10.1 Testing Methodology to confirm Bauxite Residue Neutralisation**

As per the requirements of IPPC Licence Condition 8.4.20, AAL shall, in due course, submit a proposal to the Agency for agreement on the scope and frequency of the testing methods to be utilised to confirm neutralisation of the bauxite residue by mud farming.

## 8.11 Raw Materials Efficiency and Waste Reduction

AAL continually strives to improve the efficiency of its processes in order to reduce the raw materials consumed and the waste produced. Table 49 shows the volumes of raw materials consumed and waste produced for 2010 and 2011. The relative consumption for each parameter is calculated as the volume consumed per tonne of alumina hydrate produced.

**Table 49 Raw Material Efficiency & Waste Reduction**

Material	2011 Consumption	Relative Consumption (Volume/tonne alumina)	2012 Consumption	Relative Consumption (Volume/tonne alumina)
<b>Alumina Produced (tonnes)</b>	1,922,208	N/A	1,924,385	N/A
<b>Bauxite Ore Consumed (tonnes)</b>	4,283,084	2.2	4,353,058	2.3
<b>Sodium Hydroxide (tonnes)</b>	115,048	0.06	118,604	0.06
<b>Sulphuric Acid (tonnes)</b>	12,362	0.01	19,919	0.01
<b>Heavy Fuel Oil (tonnes)</b>	148,667	0.1	88,821	0.0
<b>Water (m<sup>3</sup>)</b>	5,245,081	2.7	5,182,967	2.7
<b>Waste (tonnes)</b>	1,342,802	0.7	1,305,251	0.7
<b>Energy (GJ)</b>	713.8	11.7	725.9	11.9

The increase in the amount of sulphuric acid consumed in 2012 versus 2011 is reflective of the increased volume of industrial effluent neutralised before discharge. This is due primarily to the 80 hectare additional BRDA catchment area.

The reduction in heavy fuel oil consumed during 2012 is due to decreased combustion of the oil in site calciners since they were converted to a dual capability with natural gas.

## 8.12 Public Information Programme

In accordance with IPPC Licence Condition 2.2.2.7, AAL maintains a public awareness and information programme. As agreed with the Agency, copies of quarterly monitoring reports, monthly complaint reports and annual environmental reports are retained at the gatehouse on the AAL site. This documentation can be reviewed by any member of the public at all reasonable times.

AAL held a public meeting with its neighbours on the 18<sup>th</sup> December 2012. The main items on the agenda were:

- Aughinish Alumina plant performance and outlook
- BRDA operation.

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# Attachment 1 Effluent Toxicity Test Reports

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**CONFIDENTIAL REPORT  
SHANNON AQUATIC TOXICITY LABORATORY**

**Front Cover Report Sheet**

Dept. Toxicity  
Sheet no. 1 of 3 sheets

Tox F020 Ver. 2.2

**Customer**  
Aughinish Alumina Ltd  
Askeaton  
Co. Limerick

**Title**  
Toxicological analysis of an  
effluent sample

Attn: Mr. Eoin Brennan

Report reference: 12T062

Order no.: P4006599

Report by: Robert Hernan

Date received: 19.06.12

Approved by: Kathleen O' Rourke  
Toxicologist

Copies to: R.6. Files

Date of issue: 28.06.12

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Test report relates only to the sample(s) tested

**TOXICOLOGICAL ANALYSIS REPORT**

Form No.: ToxF035-1 Ver 2.3

**TEST RESULTS**

**Customer:** Aughinish Alumina

**Customer sample description:** Effluent, W1-1 A/B, composite, 18.06.12

**Tox. Ref. No.:** 12T062

**Test Date:** 20.06.12

Test Parameter	Test Results		95% Confidence Limits % vol./vol.	Method of Calculation
	Concentration % vol./vol.	Toxic Units		
48 h LC <sub>50</sub> to <i>Tisbe battagliai</i>	>32	<3.1	n/a	n/a
30 min EC <sub>50</sub> to <i>Vibrio fischeri</i>	>45	<2.2	n/a	n/a

**Comments:**

**48 h LC<sub>50</sub> to *Tisbe battagliai***

No mortality occurred at 32% vol./vol.

**30 min EC<sub>50</sub> to *Vibrio fischeri***

Less than 29% light inhibition occurred at 45% vol./vol.  
- compared to the control.

**Test Method(s): (see Appendix on back of page 3)**

Method 3: Marine copepod, *Tisbe battagliai*

Method 2: Marine bacterium, *Vibrio fischeri*

**TOXICOLOGICAL ANALYSIS REPORT**

Form No.: ToxF035-2 Ver 2.4

**SAMPLE INFORMATION**

	<b>SATL</b>	<b>Customer</b>	<b>Other</b>
<b>Sampled by:</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Collected by:</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

<b>Tox Ref. No.</b>	12T062
<b>Sampling procedure</b>	n/a
<b>Date of analysis</b>	19.06.12
<b>Storage conditions (°C)</b>	3±3
<b>Temperature (°C)</b>	5.6
<b>pH (at 5.2°C)</b>	8.2
<b>Dissolved oxygen (mg/l)</b>	6.5
<b>Dissolved oxygen (% saturation)</b>	54
<b>Conductivity (mS/cm at 25°C)</b>	9.6
<b>Salinity (ppt at 20°C)</b>	5.2

**CONFIDENTIAL REPORT  
SHANNON AQUATIC TOXICITY LABORATORY**

**Front Cover Report Sheet**

Dept. Toxicity  
Sheet no. 1 of 3 sheets

Tox F020 Ver. 2.2

Customer  
Aughinish Alumina Ltd  
Askeaton  
Co Limerick

Title  
Toxicological analysis of an  
effluent sample

Attn: Mr. Eoin Brennan

Report reference: 12T137

Order no.: P4013702

Report by: Kathleen O' Rourke *KO'Rourke*  
Robert Hernan *RHernan*

Date received: 05.12.12

Approved by: Ann Harte *Ann Harte*  
Quality Manager

Copies to: R.6. Files

Date of issue: 21.12.12

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Test report relates only to the sample(s) tested

**TOXICOLOGICAL ANALYSIS REPORT**

Form No.: ToxF035-1 Ver 2.3

**TEST RESULTS**

**Customer:** Aughinish Alumina Limited

**Customer sample description:** Effluent composite, W1-1A/B, 04.12.12

**Tox. Ref. No.:** 12T137

**Test Date:** 11.12.12 – *Tisbe battagliai*  
07.12.12 – *Vibrio fischeri*

Test Parameter	Test Results		95% Confidence Limits % vol./vol.	Method of Calculation
	Concentration % vol./vol.	Toxic Units		
48 h LC <sub>50</sub> to <i>Tisbe battagliai</i>	>32	<3.1	n/a	n/a
30 min EC <sub>50</sub> to <i>Vibrio fischeri</i>	>45	<2.2	n/a	n/a

**Comments:**

**48 h LC<sub>50</sub> to *Tisbe battagliai***

No mortality occurred at 100% vol./vol.

**30 min EC<sub>50</sub> to *Vibrio fischeri***

Less than 38% light inhibition occurred at 45% vol./vol.  
- compared to the control.

**Test Method(s): (see Appendix on back of page 3)**

Method 3: Marine copepod, *Tisbe battagliai*

Method 2: Marine bacterium, *Vibrio fischeri*

**TOXICOLOGICAL ANALYSIS REPORT**

Form No.: ToxF035-2 Ver 2.4

**SAMPLE INFORMATION**

	<b>SATL</b>	<b>Customer</b>	<b>Other</b>
<b>Sampled by:</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Collected by:</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

<b>Tox Ref. No.</b>	12T137
<b>Sampling procedure</b>	n/a
<b>Date of analysis</b>	06.12.12
<b>Storage conditions (°C)</b>	3±3 - <i>V.fischeri</i> ≤-20 - <i>T.battagliai</i>
<b>Temperature (°C)</b>	13.2
<b>pH (at 11.7°C)</b>	8.1
<b>Dissolved oxygen (mg/l)</b>	9.0
<b>Dissolved oxygen (% saturation)</b>	85
<b>Conductivity (mS/cm at 25°C)</b>	8.4
<b>Salinity (ppt at 20°C)</b>	4.6

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## **Attachment 2 Waste Analysis Results**

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**Waste Monitoring Results**  
Monthly Report

Ref: Q. 1 2012

Emission Point Reference	Description	Date	IPPCL Limits	pH	Dry matter %	Chloride mg/Kg	Fluoride mg/Kg	Soda mg/Kg	Total Alkalinity mg/Kg CaCO <sub>3</sub>	Al*	As*	Cd*	Cr*	Cu*	Fe*	Pb*	Mg*	Hg*	Ni*	Ti*	Zn*		
										mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
C.4 Waste Monitoring	Red Mud	Jan	N/A	12.3	58	33	51	6920	11804	22129	0.276	< 0.01	195	3.115	12092	3.92	73.99	0.0184	0.848	6654	7.46		
	Sand	Jan	N/A	12.2	81	18	50	4832	8389	12520	0.864	< 0.01	152.7	2.06	33386	6.50	324	0.021	2.332	1859	3.96		
	Salt Cake	Jan	N/A	13.2	57	2654	744	218002	325166	76778	27.49	< 0.01	0.0887	1.20	16.72	< 0.01	7.03	0.580	1.397	1.112	12.80		
	Salt Cake	Feb	N/A	13.1	57	698	716	213116	314571	53279	33.23	< 0.01	< 0.01	0.83	19.26	< 0.01	11.9	0.605	0.58	0.82	1.24		
	Salt Cake	Mar	N/A	13.3	56	767	1040	212381	310528														
					pH	--	Chloride mg/l	Fluoride mg/l	Soda mg/l	Total Alkalinity mg/l CaCO <sub>3</sub>	Al* mg/l	As* µg/l	Cd* µg/l	Cr* µg/l	Cu* µg/l	Fe* µg/l	Pb* µg/l	Mg* mg/l	Hg* µg/l	Ni* µg/l	Ti* µg/l	Zn* µg/l	
	Red Mud stack Leachate	Jan	N/A	11.0	--	11	17.2	2200	3401	167.8	223.6	0.669	18.75	19.3	341.7	<0.38	2.914	5.624	3.044	96.2	< 4.6		
	Red Mud stack Leachate	Feb	N/A	11.0	--	64	20.9	2900	5712	176	228	0.441	4.629	6.762	247.8	<0.38	< 0.55	6.764	1.222	56.18	< 4.6		
	Red Mud stack Leachate	Mar	N/A	10.8	--	< 1	6.7	3760	3902	193	175.4	0.43	9.64	4.82	62.4	2.60	3.14	5.95	1.84	< 5	< 4.6		
					pH	Dry matter %	Organic matter %	N mg/l	P mg/l	--	Al* mg/l	As* µg/l	Cd* µg/l	Cr* µg/l	Cu* µg/l	Fe* µg/l	Pb* µg/l	Mg* mg/l	Hg* µg/l	Ni* µg/l	Ti* µg/l	Zn* µg/l	
	Sanitary Sludge	Jan	N/A	6.6	0.92	99.7	362.9	118.7	--	258800	89.54	5.697	468.1	5469	33980	75.01	2.914	0.163	163.5	100.1	3335		
Sanitary Sludge	Feb	N/A	7.2	0.79	99.7	344.0	144.5	--	890.5	3.584	< 0.14	< 0.43	17.37	839.3	< 0.2	15.23	0.05	16.42	< 5	34.24			
Sanitary Sludge	Mar	N/A	7.2	0.87	99.8	394.0	106.0	--	208.7	0.878	< 0.14	< 0.43	4.186	1320	2.25	17.25	0.031	27.38	< 5	37.91			

\*Metal analysis and Sanitary Sludge analysis : Fitz Scientific

Metal analysis for Salt Cake (March) not available in time for Report

**Waste Monitoring Results**  
Monthly Report

**Ref: Q. 2 2012**

Emission Point Reference	Description	Date	IPPCL Limits	pH	Dry matter %	Chloride mg/Kg	Fluoride mg/Kg	Soda mg/Kg	Total Alkalinity mg/Kg CaCO <sub>3</sub>	Al*	As*	Cd*	Cr*	Cu*	Fe*	Pb*	Mg*	Hg*	Ni*	Ti*	Zn*		
										mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
C.4 Waste Monitoring	Red Mud	April	N/A	11.9	59	14	61	4626	8097	35308	0.459	< 10	219.88	2.385	362	4.62	69.64	< 0.2	0.600	4566	2.39		
	Sand	April	N/A	11.8	81	7	40	3751	6351	12066	0.756	< 10	131.8	88.41	1623	5.23	230.8	< 0.2	0.695	1736	2.95		
	Salt Cake	April	N/A	13.2	57	684	787	218915	321290	76153	26.19	< 10	0.136	1.76	27.56	0.064	10.89	0.533	1.857	1.454	1.55		
	Salt Cake	May	N/A	13.2	56	686	797	205853	323176	73370	30.39	< 10	0.15	1.93	20.77	< 10	9.94	0.830	1.49	0.78	2.59		
	Salt Cake	June	N/A	13.1	57	658	1381	209395	311333														
					pH	--	Chloride mg/l	Fluoride mg/l	Soda mg/l	Total Alkalinity mg/l CaCO <sub>3</sub>	Al* mg/l	As* µg/l	Cd* µg/l	Cr* µg/l	Cu* µg/l	Fe* µg/l	Pb* µg/l	Mg* mg/l	Hg* µg/l	Ni* µg/l	Ti* µg/l	Zn* µg/l	
	Red Mud stack Leachate	April	N/A	11.6	--	65	31.0	4000	5988	255	575.9	1.20	34.76	39.68	404.8	8.999	0.651	12.82	7.802	76.52	< 4.6		
	Red Mud stack Leachate	May	N/A	10.9	--	91	30.0	5000	7533	5.51	66.74	0.113	1.17	18.34	91.95	20.2	< 0.55	13.79	4.218	< 5	7.337		
	Red Mud stack Leachate	June	N/A	11.0	--	47	36.5	4200	6617	3.60	175.5	1.504	< 0.93	61.22	13.66	0.84	< 0.55	13.58	6.75	< 5	5.46		
					pH	Dry matter %	Organic matter %	N mg/l	P mg/l	--	Al* µg/l	As* µg/l	Cd* µg/l	Cr* µg/l	Cu* µg/l	Fe* µg/l	Pb* µg/l	Mg* mg/l	Hg* µg/l	Ni* µg/l	Ti* µg/l	Zn* µg/l	
	Sanitary Sludge	April	N/A	7.2	0.78	99.7	391.4	9.2	--	96890	35.61	7.289	556.7	3930	21000	91.31	30.89	8.355	330.4	142.2	3540		
Sanitary Sludge	May	N/A	7.2	0.79	99.7	304.9	4.1	--	104600	24.46	8.189	539.2	4352	37750	112.4	40.07	7.07	283.4	62.15	3992			
Sanitary Sludge	June	N/A	7.2	0.57	99.8	257.1	43.2	--	60790	40.47	5.814	316	3188	22340	57.35	36.97	5.767	157.3	116.5	2954			

\*Metal analysis and Sanitary Sludge analysis : Fitz Scientific

Metal analysis for Salt Cake (June) not available in time for Report

**Waste Monitoring Results**  
Monthly Report

**Ref: Q. 3 2012**

Emission Point Reference	Description	Date	IPPCL Limits	pH	Dry matter %	Chloride mg/Kg	Fluoride mg/Kg	Soda mg/Kg	Total Alkalinity mg/Kg CaCO <sub>3</sub>	Al*	As*	Cd*	Cr*	Cu*	Fe*	Pb*	Mg*	Hg*	Ni*	Ti*	Zn*	
										mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
C.4 Waste Monitoring	Red Mud	July	N/A	11.7	58	27	70	5307	9328	12001	< 0.01	< 0.01	2.92	2.068	98.92	< 0.01	30.63	0.0044	< 0.01	89.236	0.613	
	Sand	July	N/A	12.3	82	40	45	3716	6674	10092	< 0.01	< 0.01	105.5	1.20	18993	4.98	264.1	< 0.0002	0.52	805.20	2.64	
	Salt Cake	July	N/A	13.2	57	650	1062	208205	314695	51326	29.78	< 10	< 10	1.43	14.22	< 0.01	20.6	0.322	1.017	0.123	1.79	
	Salt Cake	Aug	N/A	13.2	56	824	1393	210697	312725	52115	29.52	0.0126	0.1026	1.56	20.15	< 0.01	12.47	0.480	1.15	0.80	1.951	
	Salt Cake	Sept	N/A	13.2	56	648	961	208166	309795	64870	25.65	< 0.01	0.0748	1.78	29.215	< 0.01	15.21	1.240	0.944	1.25	1.473	
					pH	--	Chloride mg/l	Fluoride mg/l	Soda mg/l	Total Alkalinity mg/l CaCO <sub>3</sub>	Al* mg/l	As* µg/l	Cd* µg/l	Cr* µg/l	Cu* µg/l	Fe* µg/l	Pb* µg/l	Mg* mg/l	Hg* µg/l	Ni* µg/l	Ti* µg/l	Zn* µg/l
		Red Mud stack Leachate	July	N/A	12.0	--	1.2	19.0	3600	5081	2.01	77.05	0.83	9.69	11.53	< 11.1	< 0.12	< 0.55	6.23	3.299	< 5	< 3.73
		Red Mud stack Leachate	Aug	N/A	11.1	--	162	43.5	3897	3815	5.39	324.3	1.87	9.905	19.74	< 3.7	< 3.8	< 0.55	13.32	2.613	< 5	< 4.6
		Red Mud stack Leachate	Sept	N/A	10.4	--	382	20.6	3408	3579	75.56	518.3	0.758	5.027	11.76	7.579	<0.38	3.668	10.15	5.69	< 5	< 4.6
					pH	Dry matter %	Organic matter %	N mg/l	P mg/l	--	Al* µg/l	As* µg/l	Cd* µg/l	Cr* µg/l	Cu* µg/l	Fe* µg/l	Pb* µg/l	Mg* mg/l	Hg* µg/l	Ni* µg/l	Ti* µg/l	Zn* µg/l
	Sanitary Sludge	July	N/A	7.2	0.69	99.8	399.0	16.7	--	55310	25.03	12.05	805.6	5813	33290	103.9	25.4	6.059	181.1	111.5	5598	
	Sanitary Sludge	Aug	N/A	7.4	0.54	99.9	261.9	42.6	--	39850	< 0.22	7.358	358.9	3386	29740	52.8	15.68	3.257	116.8	178.2	3025	
	Sanitary Sludge	Sept	N/A	7.3	0.51	99.9	255.9	35.3	--	35490	10.76	6.103	279.9	3975	30160	68.41	18.47	0.611	90.74	243.7	3197	

\*Metal analysis and Sanitary Sludge analysis : Fitz Scientific

**Waste Monitoring Results**  
Monthly Report

**Ref: Q. 4 2012**

Emission Point Reference	Description	Date	IPPCL Limits	pH	Dry matter %	Chloride mg/Kg	Fluoride mg/Kg	Soda mg/Kg	Total Alkalinity mg/Kg CaCO <sub>3</sub>	Al*	As*	Cd*	Cr*	Cu*	Fe*	Pb*	Mg*	Hg*	Ni*	Ti*	Zn*		
										mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
C.4 Waste Monitoring	Red Mud	Oct	N/A	12.4	59	26	71	5685	9996	32790	0.063	< 10	256.509	2.739	10780.30	5.058	41.21	< 0.0002	0.707	1550	1.23		
	Sand	Oct	N/A	12.2	81	6	37	3419	6220	8754	< 10	< 10	44.4	1.47	14795	5.70	254.54	< 0.0002	0.700	74.97	3.07		
	Salt Cake	Oct	N/A	13.3	56	613	1055	196928	315819	2272	24.79	< 10	0.129	2.07	34.03	< 10	13.54	0.402	1.469	2.047	2.31		
					pH	--	Chloride mg/l	Fluoride mg/l	Soda mg/l	Total Alkalinity mg/l CaCO <sub>3</sub>	Al*	As*	Cd*	Cr*	Cu*	Fe*	Pb*	Mg*	Hg*	Ni*	Ti*	Zn*	
											mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	µg/l	µg/l	µg/l	µg/l	
	Red Mud stack Leachate	Oct	N/A	10.7	--	72.8	29.5	4200	4434	113	387.2	0.70	40.71	40.11	110.6	1.167	1.706	8.47	9.373	115.2	< 4.6		
	Red Mud stack Leachate	Nov	N/A	11.3	--			2980		27.44	26.64	0.278	8.954	10.75	< 3.7	< 3.8	< 0.55	0.706	3.337	14.45	< 4.6		
					pH	Dry matter %	Organic matter %	N mg/l	P mg/l	--	Al*	As*	Cd*	Cr*	Cu*	Fe*	Pb*	Mg*	Hg*	Ni*	Ti*	Zn*	
											µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	µg/l	µg/l	µg/l	µg/l	
	Sanitary Sludge	Oct	N/A	7.1	0.63	99.9	344.0	39.2	--	52150	14.8	7.638	318.8	4996	32710	108.2	16.27	7.737	138.3	95.76	4051		
Sanitary Sludge	Nov	N/A	7.3	0.94	99.8	415.8	2.7	--	55010	26.41	7.38	301.1	7283	32500	44.56	26.78	5.06	186.9	87.22	4633			

\*Metal analysis and Sanitary Sludge analysis : Fitz Scientific

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## **Attachment 3**

# **Energy Efficiency Report 2012**

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# **Energy Efficiency Report 2012**

RUSAL Aughinish

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## **Background**

This report summarises the 2012 energy performance for inclusion in the Annual Environmental Report for RUSAL Aughinish. Reports for earlier years were included in previous Environmental Reports.

### **Total Steam Efficiency**

Plot 1 shows the monthly average total steam efficiency as monthly and year to date results.

The monthly target varied in line with expected equipment outages; however, these events did not always occur as scheduled.

Production and efficiencies were adversely affected by a series of unscheduled events in 2012. The main issues were:

- Contamination of the river Deel forced Limerick County Council to limit water availability and caused major a production cut from 18 to 22 Jan.
- Failure of 22 kV power cables caused 3 emergency shutdowns. The original cables are now completely replaced throughout the plant.
- Unplanned reduced production due to process upsets occurred on 27 Feb and 4 Oct.

Despite these problems we achieved a total steam efficiency which was only marginally above the target for 2012. Apart from the events listed above other equipment problems adversely affected efficiency throughout Q4.

In Q3 we achieved the best quarterly total steam efficiency result in the plant's history. The underlying reasons for this were steady operation at a high production rate and good heat recovery. Although equipment outages occurred in Q3 none of the key energy items was out for an extended period during this time. The key energy equipment items are the digestion flash tanks FT1, FT2, & FT3.

The 2012 result was again worse than the best ever performance (achieved in 2008) because of the reasons given above. However the performance in Q3 indicates that we would have had a record result had the events not occurred.

In 2012 we re-tubed the digestion area heaters 6C & 8B. We also repaired damage and replaced some tubes on heaters 2A, 2B, & 5B and de-scaled all tubes in several heaters which were partly blocked with solids.

### **Total Power Efficiency**

Plot 2 shows the monthly average total power efficiency as monthly and year to date results. The monthly target was constant throughout the year.

Power efficiency was poor in Jan/Feb due to production issues mentioned earlier but improved thereafter apart from May and Oct which featured unplanned outages.

The average for 2012 was worse than the best ever performance (achieved in 2008). The reason for this is the same as that for total steam efficiency and we believe that we would have achieved a record result had the events not occurred. The average power rate increased in line with production.

In 2012 we replaced the 660 kW Laurence Scott NS motor on charge pump 2B and the 660 kW General Electric motor on charge pump 2C with high efficiency 900 kW

Siemens units. The only remaining NS motors are on the 5<sup>th</sup> stage injection pumps. We have no plans to replace them in the immediate future.

### **Other Energy Issues**

We operated the 3 calciners on natural gas throughout 2012; this reduced CO<sub>2</sub> emissions and cost.

In 2012 we completed engineering design on a project to install 2 new gas fired boilers, each with a capacity of 150 t/hr steam. RUSAL approved the project in Dec. We placed the order in March 2013 and will start installation onsite during Q1 2014. The gas boilers will reduce CO<sub>2</sub> emissions and energy cost but we will retain the option of using the oil fired boilers when required.

We again qualified as a high quality CHP site under the UK CHPQA Self-assessment Scheme. We are also certified as high efficiency CHP through the Commission for Energy Regulation's scheme.

We made no further progress on the prototype inter-condenser in Area 41.

### **Energy Management System**

In 2004 Aughinish implemented an Energy Management System (EnMS) based on the Danish Standard DS2403. We were the first company in Ireland and the first alumina plant in the world to implement such a system. Follow-up audits through to 2008 confirmed that we met the standard's requirements.

In 2009 we ceased all external audits as part of a cost cutting program to ensure the plant's survival. However, we retained the structures on DS2403 in terms of monitoring energy performance and planning improvements. Also in 2009 the European Standard EN16001 replaced DS2403, which became obsolete. In 2011 ISO50001 replaced EN16001, which in turn became obsolete.

Given the changes which were occurring at the time we decided to await the formal release of ISO50001 before resuming external auditing. In Dec 2012 we underwent a stage 1 audit with Certification Europe and in 2013 we plan to complete a stage 2 audit and have our EnMS certified as compliant with the ISO 50001 standard.

## Energy Programme for 2013

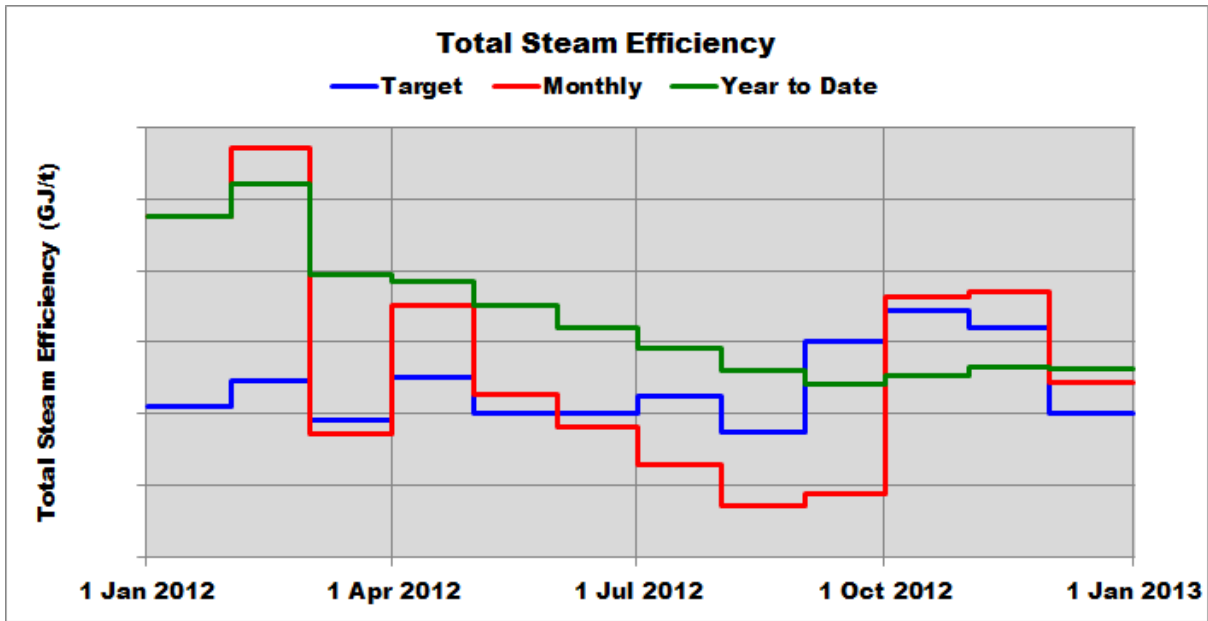
The main projects affecting heat recovery are:

- Implement the Advanced Wash Project  
This redirects most of the first washer overflow stream from the blow-off area to the first growth tank in the precipitation area. It de-bottlenecks the blow-off pumps and decanters, facilitating an increase in production. Steam use will increase slightly because of a lower liquor temperature but the higher production will improve total steam usage efficiency.
- Operate with 3 sweetening pumps online  
We currently have 3 sweetening pumps, 32C/D/E, with any 2 in service and the third out for maintenance or on standby. We will install a facility to run all 3 pumps simultaneously. This will increase the production from sweetening, which is more energy efficient. We will still have to run 2 pumps when maintenance is required on the 3<sup>rd</sup> pump.
- Replace 12C Boiler Feed Water Heater with a new unit.  
We installed 12C heater in 2000 to heat boiler feed water from 80 to 120 C. It has no standby and the cost impact of taking it out for maintenance and/or cleaning is prohibitive. Heater performance has deteriorated and it now only delivers 100 C. The new heater will be installed in Q2. It is a replacement for the original which we will re-tube onsite and re-install in 3-4 years.
- Improve steam efficiency when significant equipment is out of service.  
Although we achieved 5.59 GJ/t total steam usage efficiency in Q3 the usage is greater when key equipment is not in service. We will identify and implement procedure to minimise the impact of such outages on energy usage efficiency.
- Re-tube two heaters in the digestion area.
- Continue test work on the Area 41 inter-condenser.

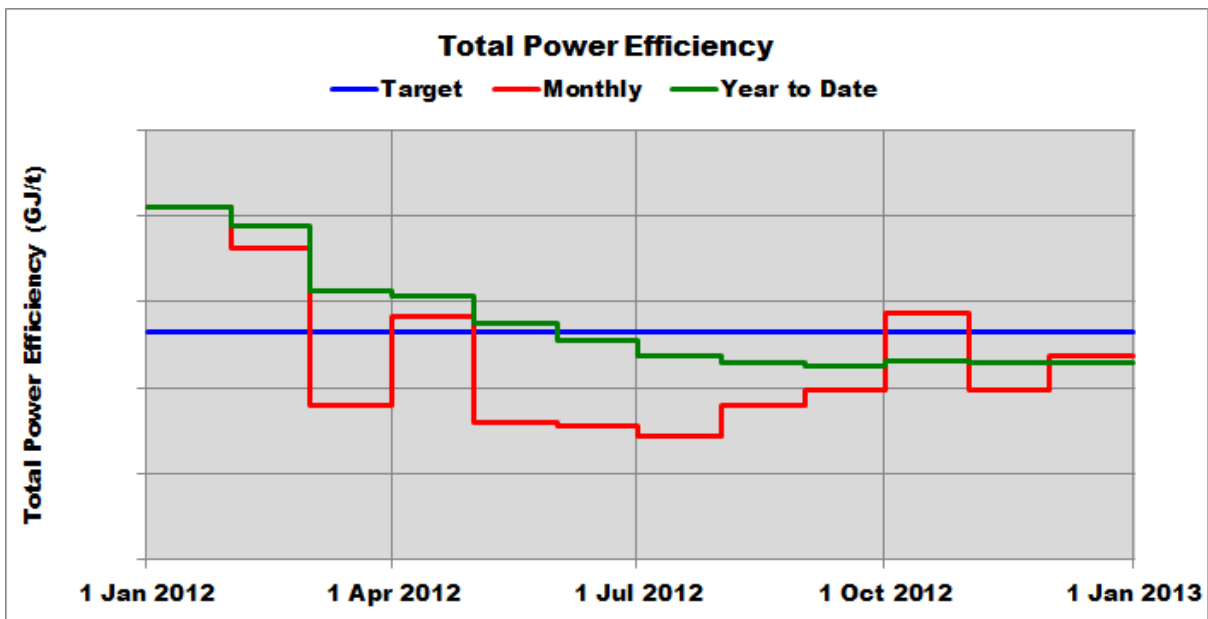
The production target for 2013 is 1,990,000 t. We expect to achieve a total steam efficiency which will be better than that achieved in 2008, our best ever annual performance.

We have no significant projects affecting power. The higher production will improve total power efficiency and we expect to achieve a value better than that in 2008, which was also our best ever performance.

Plot 1 - Total Steam Efficiency in 2012



Plot 2 - Total Power Efficiency in 2012



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## **Attachment 4**

# **AER/PRTR Emissions Data Information**

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[Guidance to completing the PRTR workbook](#)

# AER Returns Workbook

Version 1.1.16

<b>REFERENCE YEAR</b>	2012
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## 1. FACILITY IDENTIFICATION

Parent Company Name	Aughinish Alumina Limited
Facility Name	Aughinish Alumina Limited
PRTR Identification Number	P0035
Licence Number	P0035-05

### Waste or IPPC Classes of Activity

No.	class name
30.10	General The recovery or disposal of waste in a facility, within the meaning of the Act of 1996, which facility is connected or associated with another activity specified in this Schedule in respect of which a licence or revised licence under Part IV is in force or in respect of which a licence under the said Part is or will be required.
11.1	The burning of any fuel in a boiler or furnace with a nominal heat output exceeding 50MW
2.2	
Address 1	Askeaton Island
Address 2	Askeaton
Address 3	County Limerick
Address 4	
	Limerick
Country	Ireland
Coordinates of Location	-9.05928 52.6243
River Basin District	IEGBNISH
NACE Code	2442
Main Economic Activity	Aluminium production
<b>AER Returns Contact Name</b>	Liam Fleming
<b>AER Returns Contact Email Address</b>	liam.fleming@augh.com
<b>AER Returns Contact Position</b>	Environmental Coordinator
<b>AER Returns Contact Telephone Number</b>	061 604232
<b>AER Returns Contact Mobile Phone Number</b>	
<b>AER Returns Contact Fax Number</b>	061 604090
<b>Production Volume</b>	0.0
<b>Production Volume Units</b>	
<b>Number of Installations</b>	0
<b>Number of Operating Hours in Year</b>	0
<b>Number of Employees</b>	0
<b>User Feedback/Comments</b>	
<b>Web Address</b>	

## 2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
4(b)	Gases, such as ammonia, chlorine or hydrogen chloride, fluorine or hydrogen fluoride, carbon oxides, sulphur compounds, nitrogen oxides, hydrogen, sulphur dioxide, carbonyl chloride, Acids, such as chromic acid, hydrofluoric acid, phosphoric acid, nitric acid, hydrochloric acid, sulphuric acid, oleum, sulphurous acids, Bases, such as ammonium hydroxide, potassium hydroxide, sodium hydroxide, Salts, such as ammonium chloride, potassium chlorate, potassium carbonate, sodium carbonate, perborate...
5(a)	Installations for the recovery or disposal of hazardous waste
5(d)	Landfills
50.1	General

## 3. SOLVENTS REGULATIONS (S.I. No. 543 of 2002)

Is it applicable?	No
Have you been granted an exemption ?	
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	
Is the reduction scheme compliance route being used ?	

## 4. WASTE IMPORTED/ACCEPTED ONTO SITE

[Guidance on waste imported/accepted onto site](#)

Do you import/accept waste onto your site for on-site treatment (either recovery or disposal activities) ?	No
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This question is only applicable if you are an IPPC or Quarry site

**SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS**

RELEASES TO AIR		Please enter all quantities in this section in KGs											QUANTITY			
No. Annex II	POLLUTANT Name	M/C/E	METHOD		Boiler House (Emission Point Reference No: A1)	Calciner Stack (A2)	Gas Turbines (A3-A & A3-B)	Bauxite Crusher Scrubber Exhaust (6)	Alumina Loader Dust Fan (11)	Alumina Loader Dust Fan (12)	Alumina Silo's Exhaust Fan (17)	Alumina Silo's Exhaust Fan (18)	Alumina Silo's Exhaust Fans (19 & 20)	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
			Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	Emission Point 4	Emission Point 5	Emission Point 6	Emission Point 7	Emission Point 8	Emission Point 9			
08	Nitrogen oxides (NOx/NO2)	C	OTH	Calculation based on fuel usage & continuous monitoring (boilers & gas turbines)	610032.6	538506.8	297448.0	0.0	0.0	0.0	0.0	0.0	0.0	1445987.4	0.0	0.0
11	Sulphur oxides (SOx/SO2)	C	OTH	Calculation based on fuel usage	1620128.2	0.0	10000.0	0.0	0.0	0.0	0.0	0.0	0.0	1630128.2	0.0	0.0
86	Particulate matter (PM10)	C	OTH	Calculation based on fuel usage	37525.0	97544.1	0.0	1495.4	95.1	1285.7	1889.9	1652.4	2162.7	143650.3	0.0	0.0
03	Carbon dioxide (CO2)	C	ETS		288904437.0	313365278.9	758495891.8	0.0	0.0	0.0	0.0	0.0	0.0	#####	0.0	0.0

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

**SECTION B : REMAINING PRTR POLLUTANTS**

RELEASES TO AIR		Please enter all quantities in this section in KGs											QUANTITY		
No. Annex II	POLLUTANT Name	M/C/E	METHOD		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year							
			Method Code	Designation or Description	0.0	0.0	0.0	0.0							
						0.0	0.0	0.0	0.0						

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

**SECTION C : REMAINING POLLUTANT EMISSIONS (As required in your Licence)**

RELEASES TO AIR		Please enter all quantities in this section in KGs											QUANTITY		
Pollutant No.	POLLUTANT Name	M/C/E	METHOD		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year							
			Method Code	Designation or Description	0.0	0.0	0.0	0.0							
						0.0	0.0	0.0	0.0						

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

**Additional Data Requested from Landfill operators**

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CH4) emission to the environment under T(total) KG/yr for Section A: Sector specific PRTR pollutants above. Please complete the table below:

Landfill:		Aughinish Alumina Limited			
Please enter summary data on the quantities of methane flared and / or utilised		M/C/E	METHOD		Facility Total Capacity m3 per hour
T (Total) kg/Year			Method Code	Designation or Description	
Total estimated methane generation (as per site model)	0.0				N/A
Methane flared	0.0				0.0 (Total Flaring Capacity)
Methane utilised in engine/s	0.0				0.0 (Total Utilising Capacity)
Net methane emission (as reported in Section A above)	0.0				N/A

4.2 RELEASES TO WATERS

[Link to previous years emissions data](#)

| PRTR# : P0035 | Facility Name : Aughinish Alumina Limited | Filename : P0035\_2012.xls | Return Year : 2012 |

28/03/2013 13:22

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, should NOT be submitted under AER / PRTR Reporting as this only concerns Releases from your facility

RELEASERS TO WATERS				Please enter all quantities in this section in KGs				
POLLUTANT		Method Used		QUANTITY		QUANTITY		
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Industrial Effluent (W1-1) Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
17	Arsenic and compounds (as As)	M	OTH	APHA SMEW & WW 3125	197.3	197.3	0.0	0.0
18	Cadmium and compounds (as Cd)	M	OTH	APHA SMEW & WW 3126	3.2	0.0	0.0	0.0
19	Chromium and compounds (as Cr)	M	OTH	APHA SMEW & WW 3127	21.4	0.0	0.0	0.0
20	Copper and compounds (as Cu)	M	OTH	APHA SMEW & WW 3128	35.4	0.0	0.0	0.0
21	Mercury and compounds (as Hg)	M	OTH	APHA SMEW & WW 3129	24.9	0.0	0.0	0.0
22	Nickel and compounds (as Ni)	M	OTH	APHA SMEW & WW 3130	41.3	0.0	0.0	0.0
23	Lead and compounds (as Pb)	M	OTH	APHA SMEW & WW 3131	23.2	0.0	0.0	0.0
24	Zinc and compounds (as Zn)	M	OTH	APHA SMEW & WW 3132	32.7	0.0	0.0	0.0

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING PRTR POLLUTANTS

RELEASERS TO WATERS				Please enter all quantities in this section in KGs				
POLLUTANT		Method Used		QUANTITY		QUANTITY		
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION C : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

RELEASERS TO WATERS				Please enter all quantities in this section in KGs					
POLLUTANT		Method Used		QUANTITY		QUANTITY			
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Industrial Effluent (W1-1) Emission Point 1	Sanitary Effluent Emission Point 2	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
355	Aluminium	M	OTH	APHA SMEW & WW 3125	6698.1	0.0	6698.1	0.0	0.0
303	BOD	M	OTH	APHA SMEW & WW 2540D	425597.0	72.2	425669.2	0.0	0.0
314	Fats, Oils and Greases	M	OTH	APHA SMEW & WW 2540D	4989.3	0.0	4989.3	0.0	0.0
357	Iron	M	OTH	APHA SMEW & WW 3126	308.8	0.0	308.8	0.0	0.0
240	Suspended Solids	M	OTH	APHA SMEW & WW 2540D	56961.1	40.5	57001.6	0.0	0.0
320	Magnesium	M	OTH	APHA SMEW & WW 3127	29278.4	0.0	29278.4	0.0	0.0

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

4.3 RELEASES TO WASTEWATER OR SEWER

[Link to previous years emissions data](#)

| PRTR# : P0035 | Facility Name : Aughinish Alumina Limited | Filename : P0035\_2012.xls | Return Year

28/03/2013 13:22

**SECTION A : PRTR POLLUTANTS**

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
No. Annex II	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
			Method Code	Designation or Description				
					0.0	0.0	0.0	0.0

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

**SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)**

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
Pollutant No.	Name	M/C/E	Method Used		Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
			Method Code	Designation or Description				
					0.0	0.0	0.0	0.0

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

4.4 RELEASES TO LAND

[Link to previous years emissions data](#)

| PRTR# : P0035 | Facility Name : Aughinish Alumina Limited | Filename : P0035\_2012.xls | Return Year : 2012 |

28/03/2013 13:22

**SECTION A : PRTR POLLUTANTS**

POLLUTANT			METHOD			Please enter all quantities in this section in KGs		
RELEASERS TO LAND			METHOD USED			QUANTITY		
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	
						0.0	0.0	0.0

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

**SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)**

POLLUTANT			METHOD			Please enter all quantities in this section in KGs		
RELEASERS TO LAND			METHOD USED			QUANTITY		
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	
						0.0	0.0	0.0

\* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

(PPT01 - P1021) Facility Name : Aughinish Alumina Limited | Filename : P0035\_2012\_46 | Return Year : 2012 |

29/03/2013 11:21

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Licence/Permit No of Receiving Facility Name and License/Permit No of Receiver/Disposer	Licence/Permit No of Receiving Facility Name and License/Permit No of Receiver/Disposer	Name and License / Permit No. and Address of Final Receiver / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Receiver / Disposer Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	01 03 07	Yes	15808.0	salt cake	D1	C	Volume Calculation	Onsite of generic Licence P0035-05	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Co Limerick,Ireland
Within the Country	01 03 99	No	5590.0	lime grits	D1	C	Volume Calculation	Onsite of generic Licence P0035-05	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland
Within the Country	01 03 99	No	16709.0	process wastes (sand, scales, tank sludges)	D1	C	Volume Calculation	Onsite of generic Licence P0035-05	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland
Within the Country	01 03 99	No	1183356.0	red mud	D1	C	Volume Calculation	Onsite of generic Licence P0035-05	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland
Within the Country	13 07 01	Yes	38.4	waste oil and diesel	D9	M	Volume Calculation	Offsite in Ireland	Rita Environmental Ltd,W0192-03	Rita Environmental Ltd,W0192-03	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland
Within the Country	13 08 99	Yes	10.0	oily rags/spent oil dry absorbent	R9	C	Weighted	Offsite in Ireland	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Rita Environmental Ltd,W0192-03,Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland
Within the Country	15 01 04	No	12.5	metallic packaging/drums	R4	M	Weighted	Offsite in Ireland	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland
Within the Country	16 02 14	No	3.0	waste electrical & electronic equipment (WEEE)	R4	M	Weighted	Offsite in Ireland	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland
Within the Country	16 06 01	Yes	8.62	lead batteries	R4	C	Weighted	Offsite in Ireland	Rita Environmental Ltd,W0192-03	Rita Environmental Ltd,W0192-03	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland
Within the Country	16 11 04	No	80.0	flue stack residue - refractory waste	D1	C	Volume Calculation	Onsite of generic Licence P0035-05	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland
Within the Country	17 04 01	No	28.3	copper	R4	M	Weighted	Offsite in Ireland	Hegarty Metals Recycling,WFP-LKC-11-001-01	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland
Within the Country	17 04 07	No	918.3	mixed metals	R4	M	Weighted	Offsite in Ireland	Hegarty Metals Recycling,WFP-LKC-11-001-01	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland
Within the Country	18 01 04	No	0.028	clinical waste	D1	M	Weighted	Offsite in Ireland	SRCL,W0055-02	SRCL,W0055-02	SRCL,W0055-02	SRCL,W0055-02
Within the Country	19 08 05	No	381.9	sludges from treatment of urban waste water	D2	C	Volume Calculation	Onsite of generic Licence P0035-05	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland
Within the Country	19 12 04	No	31.5	rubber hoses	R11	M	Weighted	Offsite in Ireland	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02
Within the Country	20 01 01	No	15.4	cardboard	R3	M	Weighted	Offsite in Ireland	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02
Within the Country	20 01 01	No	1.1	paper	R3	M	Weighted	Offsite in Ireland	DGD Papers,WFP-LK-2008-09C	DGD Papers,WFP-LK-2008-09C	DGD Papers,WFP-LK-2008-09C	DGD Papers,WFP-LK-2008-09C
Within the Country	20 01 21	Yes	11.0	fluorescent tubes and other mercury-containing waste	R4	M	Weighted	Offsite in Ireland	Irish Lamp Recycling,WFP-KE-08-0348-01	Irish Lamp Recycling,WFP-KE-08-0348-01	Irish Lamp Recycling,WFP-KE-08-0348-01	Athy,Athy,Co Kildare,Co Kildare,Ireland
Within the Country	20 01 25	No	1.2	edible oil and fat	R3	E	Volume Calculation	Offsite in Ireland	Frylite Dublin Ltd,WCP-DC-10-1297-01	Frylite Dublin Ltd,WCP-DC-10-1297-01	Frylite Dublin Ltd,WCP-DC-10-1297-01	Frylite Dublin Ltd,WCP-DC-10-1297-01
Within the Country	20 01 36	No	0.08	used printer toner cartridges	R4	C	Weighted	Offsite in Ireland	Condells The Office Centre, None	Condells The Office Centre, None	Condells The Office Centre, None	Condells The Office Centre, None
Within the Country	20 01 38	No	33.1	used timber reets	R11	M	Weighted	Offsite in Ireland	Hegarty Metals Recycling,WFP-LKC-11-001-01	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland
Within the Country	20 01 38	No	77.8	wood for recycling	R3	M	Weighted	Offsite in Ireland	Hegarty Metals Recycling,WFP-LKC-11-001-01	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland	Ballysimon Road,Ballysimon Road,Limerick,Limerick,Ireland
Within the Country	20 01 38	No	15.8	wood for landfill	D1	M	Weighted	Offsite in Ireland	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02
Within the Country	20 01 39	No	45.2	plastics (empty IBC's & drums)	R9	M	Weighted	Offsite in Ireland	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland
Within the Country	20 01 99	No	31.9	conveyor belting	R11	M	Weighted	Offsite in Ireland	Quarry Plant Supplies Ltd, None	Quarry Plant Supplies Ltd, None	Quarry Plant Supplies Ltd, None	Quarry Plant Supplies Ltd, None
Within the Country	20 03 01	No	179.0	mixed municipal waste	D1	M	Weighted	Offsite in Ireland	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02	Greenstar,W0082-02
Within the Country	16 11 04	No	3.0	Flue Stack Residue (boiler ash)	D1	E	Volume Calculation	Onsite of generic Licence P0035-05	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland
To Other Countries	15 01 10	Yes	2.9	plastic containers (contaminated IBC's & drums)	R12	M	Weighted	Abroad	SRCL,W0055-02	SRCL,W0055-02	SRCL,W0055-02	Recyfuel,Not known,Zoning Industrial d'Ehein,Zoning Industrial d'Ehein,Engls,B-4480 ,Belgium
Within the Country	01 03 09	No	81835.0	Sand (from alumina production)	D1	C	Volume Calculation	Onsite of generic Licence P0035-05	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland	Aughinish Alumina Ltd.,PPC Licence P0035-05,Aughinish Island,Askeaton,Askeaton,Co Limerick,Ireland
Within the Country	16 07 08	Yes	9.32	wastes containing oil (waste oil/water washings)	R9	C	Volume Calculation	Offsite in Ireland	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Rita Environmental Ltd,W0192-03,Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland
To Other Countries	16 05 04	Yes	0.68	gases in pressure containers (including halons) containing dangerous substances- Halon cylinders	R5	M	Weighted	Abroad	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	Meridian Technical Services Ltd ,EAWML83425,14 Halley Road ,Erith ,Kent ,DA 18 4Ap,United Kingdom	14 Halley Road ,Erith ,Kent ,DA 18 4Ap,United Kingdom
To Other Countries	16 01 07	Yes	0.1	oil filters	R11	M	Weighted	Abroad	Enva Shannon,W0041-01	Enva Shannon,W0041-01	Enva Shannon,W0041-01	Enva Shannon,W0041-01
To Other Countries	17 06 01	Yes	5.5	insulation materials containing asbestos	D1	M	Weighted	Abroad	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	GroBenasper Entsorgungsgesellschaft mbh & Co. KG,eg7108,Bismohler Str. 57a,24623 GroBenasper ,Hamburg ,Germany	Bismohler Str. 57a,24623 GroBenasper ,Hamburg ,Germany
To Other Countries	15 01 11	Yes	5.0	Aerosol cans empty	D10	M	Weighted	Abroad	Rita Environmental Ltd,W0192-03	Greenogue Business Park,Rathcoole,Co. Dublin,Co. Dublin,Ireland	De-Pack Limited ,EAWML43679,Wymeswold Industrial Estate ,Burton on the Wolds ,Leicestershire ,United Kingdom	Wymeswold Industrial Estate ,Burton on the Wolds ,Leicestershire ,United Kingdom

\* Select a row by double-clicking the Description of Waste then click the delete button

[Link to previous years waste data](#)

[Link to previous years waste summary data & percentage change](#)

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## **Attachment 5**

# **Noise Survey Report 2012**

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# RUSAL Aughinish Ltd.

Aughinish Island, Askeaton, Co. Limerick.  
IPPC Licence Reg No. P0035-04




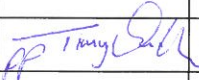
Report on

## Annual Environmental Noise Survey 2012

September 2012



## Control Sheet

<b>Document Title:</b>		Report on Annual Environmental Noise Survey 2012	<b>Document No.</b>		R1_101726_00
<b>Rev</b>	<b>Description</b>	<b>Originator</b>	<b>Reviewer</b>	<b>Change</b>	<b>Date</b>
00	Draft	TMC	POL	Draft	18/09/2012
01	Final			Final	25/09/2012

RUSAL Aughinish Ltd.  
Aughinish Island, Askeaton, Co. Limerick

## Report on Annual Environmental Noise Survey 2012

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### Attachments

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<b>Attachment D</b>	Photo Log
<b>Attachment E</b>	RUSAL Aughinish Weather Reports

## 1. Introduction

OES Consulting (OES) was commissioned by RUSAL Aughinish Ltd. to undertake their annual environmental noise assessment at their facility in Aughinish Island, Askeaton, Co. Limerick.

The noise assessment was undertaken in accordance with Conditions set out in the Integrated Pollution Prevention and Control (IPPC) Licence (Reg No. P0035-04). The relevant Conditions and Schedules of the Licence are as follows:

- In accordance with Condition 4.5 of the licence *“noise from the installation shall not give rise to sound pressure levels measured at noise sensitive locations of the installation which exceed the limit value(s).”*
- In accordance with Condition 6.13 of the licence *“the licensee shall carry out a noise survey of the site operations annually. The survey programme shall be undertaken in accordance with the methodology specified in the Agency publication ‘Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), April 2012’.”*
- In accordance with Schedule B.4 of the licence *“noise from the installation shall not give rise to sound pressure levels measured at noise sensitive locations which exceed the limit value of 55dB(A) by day and 45dB(A) by night. In addition, there shall be no clearly audible tonal or impulsive noise component in the noise emission from the activity at any noise sensitive location.”*
- In accordance with Condition C.5 *“the assessment included noise measurement assessments at nine Boundary Locations (B1 to B 9) and five Noise Sensitive Locations (NSL1 to NSL5).”*

The survey was carried out between the dates 9<sup>th</sup> to the 10<sup>th</sup> July and 21<sup>st</sup> to the 23<sup>rd</sup> August 2012 (dates inclusive). The noise survey was undertaken by Tomás McCarthy of OES.

## **2. Methodology**

The noise survey was undertaken in accordance with 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)' as published by the Environmental Protection Agency in April 2012.

The NG4 guidance document replaces the previous guidance documents in relation to the assessment and management of noise emissions from licensed facilities, namely the Environmental Noise Survey Guidance Document (commonly referred to as NG1) and Guidance Note For Noise In Relation To Scheduled Activities – 2nd Edition (commonly referred to as NG2), which has been withdrawn.

### **2.1 Measurement Locations**

The noise survey was conducted at 9 Boundary Locations (B1 to B9) and 5 Noise Sensitive Locations (NSL's) as shown in Figure 1, Attachment A and described in Table 1 overleaf.

**Table 1 Noise Monitoring Locations**

Monitoring location	GPS Coordinates	Location type	Location relative to RUSAL Aughinish installation
B1	528276 655432	Boundary	Located on the North-West corner of the jetty where ships are unloaded and loaded.
B2	528807 653808	Boundary	Located at the North East of the facility, close to the cooling towers.
B3	528676 652702	Boundary	Located towards the North side of the main access road.
B4	528153 651916	Boundary	Located to the South of the facility, close to the cattle grid.
B5	526797 652555	Boundary	Located to the Western corner of the site in the vicinity of the BRDA.
B6	528002 653635	Boundary	Located close to the side access road to the Southwest of the main plant.
B7	526713 652467	Boundary	Located to the Southwest corner of the site.
B8	527668 650952	Boundary	Located to the South of the BRDA extension.
B9	528780 651096	Boundary	Located to the Southeast of the BRDA extension.
NSL1	529168 652761	Noise sensitive location	Located approximately 600m South East of the facility along Poulawela Creek.
NSL2	529000 651731	Noise sensitive location	Located approximately 1,200m to the South East of the facility in the vicinity of a dwelling.
NSL3	527720 649969	Noise sensitive location	Located approximately 3km to the South of the facility in the townland of Oola.
NSL4	526069 652096	Noise sensitive location	Located approximately 2.6km to the South West. Located at the eastern end of Foynes Port.
NSL5	528805 651209	Noise sensitive location	Located 1.9km directly South of the facility in the vicinity of a residential building.

## 2.2 Survey Periods

In accordance with the NG4 Guidelines, three sampling periods are required at each noise sensitive location during the daytime. Two sampling periods are required during the night-time survey's.

The survey was undertaken during a typical operational production period during the daytime and night-time survey as required for compliance evaluation.

## 2.3 Weather

The weather during the daytime surveys was mild (nominally 11 to 20°C) and with a calm to light breeze (0 – 5m/s). During the night-time survey, it was calm with an occasional light breeze. Temperatures dropped to approximately below 12°C at night-time. Conditions were generally dry throughout both periods with occasional short periods of rain.

## 2.4 Instrumentation

All measurements were undertaken using a Type 1 Precision Integrating Sound Level Meter (Cirrus Optimus) and associated hardware (calibrator, tripod) and software. Measurement equipment was calibrated prior to and post day and night-time surveys. The frequency of calibration may be adjusted depending on observed instrument drift. Calibration certificates for the noise meter and calibrator are presented in Attachment B.

Details of the monitoring equipment used are provided in Table 2.

**Table 2 Monitoring Equipment**

Instrument Type	Manufacturer	Model Number	Serial Number
Sound Level Meter	Cirrus Research plc	CR:171B	G056143
Acoustic Calibrator	Cirrus Research plc	CR:515	55191
Interpretation and Interface Software	Cirrus Research plc	Noise Tools	N/A

The Sound Level Meter and associated software and accessories conform to the following standards:

- IEC 61672-1, Class 1, Group X
- IEC 60651, Type 1, Group X
- IEC 60804, Type 1, Group X
- IEC 61260, IEC 60942, Class 1
- ANSI S1.4 & ANSI S1.4A, Type 1
- ANSI S1.43, Type 1

The Acoustic Calibrator was calibrated to published data as described and recommended by IEC standard Electroacoustics – Sound Calibrators IEC 60942:2003, IEC 90942:1997, BS EN 60942:1998 and BS EN 60942:2003.

## 2.5 Procedure

Sample periods were 15 minutes for Boundary Locations and 30 minutes for Noise Sensitive Locations (NSL) during the daytime and night-time surveys. The results were saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up. The noise meter was attended by OES personnel at all times. The survey results were noted onto a Survey Record Sheet immediately following each measurement.

The meter was calibrated before, during and at the end of the survey period.

## 2.6 Measurement Parameters

The boundary survey results are presented in terms of the following five parameters:

**Noise Sensitive Location** any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.

**L<sub>Aeq</sub>** is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.

**L<sub>Amax</sub>** is the instantaneous maximum sound level measured during the sample period.

**L<sub>Amin</sub>** is the instantaneous minimum sound level measured during the sample period.

**L<sub>A10</sub>** is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

**L<sub>A90</sub>** is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise. The EPA NG4 Guidelines states that *“for some noise surveys, the L<sub>AF90,T</sub> index may be used to give a good indication of the actual noise output from the site, where the noise emissions on site are relatively steady and extraneous noises may unduly influence the measured L<sub>Aeq,T</sub>”*.

**L<sub>Ar,T</sub>** The Rated Noise Level, equal to the L<sub>Aeq</sub>/ L<sub>A90</sub> during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.

The “A” suffix denotes sound levels that have been “A-weighted” in order to account for the non-linear nature of human hearing.

**Tonal** Sounds which cover a range of only a few Hz which contains a clearly audible tone, i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.

An audible tone is normally defined as being greater than or equal to the following values in both adjacent one third octave bands:

- 15dB in low frequency one third octave bands (25Hz to 125Hz);
- 8dB in middle frequency bands (160Hz to 400Hz), and;
- 5dB in high frequency bands (500Hz to 10,000Hz).

**1/3 octave analysis** Frequency analysis of sound such that the frequency spectrum is subdivided into bands of one-third of an octave each.

All sound levels in this report are expressed in terms of decibels (dB) relative to  $2 \times 10^{-5}$  Pa.

### 3. Noise Monitoring Results

Detailed noise monitoring results of all noise monitoring locations are appended as Attachment C of the report. A summary of the survey average  $L_{Aeq}$ ,  $L_{A90}$ ,  $L_{A10}$  and A 1/3<sup>rd</sup> octave frequency analysis for day and night time measurements are outlined in Tables 3 and 4 below.

**Table 3 Daytime - Noise Monitoring Results Summary**

Noise location	$L_{Aeq}$	$L_{A90}$	$L_{A10}$	$L_{Amax}$	Tonal or Impulsive noise* (Y/N)	$L_{AR}$	Comments (ex. main noise sources on site, & extraneous noise ex. road traffic)	Is site compliant with IPPC noise limit (55dBA)?
<b>Noise Sensitive Locations - Monitoring Results</b>								
NSL 1	49	46	51	69	N	46	Distant N69 traffic, faint plant noise audible	Yes
NSL 2	53	43	53	75	N	43	Distant traffic noise from the N69, occasional passing traffic on local road	Yes
NSL 3	51	43	51	73	N	43	N69 traffic noise audible, faint plant noise audible	Yes
NSL 4	46	41	47	71	N	41	Port activities dominant, very faint air emission noise from RusAL	Yes
NSL 5	53	42	52	78	N	42	Distant traffic noise from the N69, very faint noise audible from the BRDA area	Yes
<b>Boundary Location - Noise Monitoring Results</b>								
B1	55	52	55	76	N	55	Plant Noise	N/A
B2	56	55	57	63	N	56	Plant Noise	N/A
B3	53	47	56	69	N	53	Plant Noise	N/A
B4	52	43	52	72	N	52	Plant Noise	N/A
B5	42	36	45	57	N	42	Plant Noise	N/A
B6	52	48	54	63	N	52	Plant Noise	N/A
B7	45	40	47	62	N	45	Plant Noise	N/A
B8	42	36	45	65	N	42	Plant Noise	N/A
B9	53	45	55	68	N	53	Plant Noise	N/A

**Table 4 Night -Time Noise Monitoring Results Summary**

Noise location	L <sub>Aeq</sub>	L <sub>A90</sub>	L <sub>A10</sub>	L <sub>Amax</sub>	Tonal or Impulsive noise* (Y/N)	L <sub>AR</sub>	Comments (ex. main noise sources on site, & extraneous noise ex. road traffic)	Is site compliant with IPPC noise limit (45dBA)?
Noise Sensitive Locations - Monitoring Results								
NSL 1	44	39	43	62	N	39	Distant N69 traffic, faint plant noise audible	Yes
NSL 2	46	34	38	73	N	34	Distant traffic noise from the N69, occasional passing traffic on local road	No
NSL 3	37	34	39	53	N	34	N69 traffic noise audible, faint plant noise audible	Yes
NSL 4	46	32	37	75	N	32	Port activities dominant, very faint air emission noise from RUSAL	No
NSL 5	39	34	38	68	N	34	Distant traffic noise from the N69, very faint noise audible from the BRDA area	Yes
Boundary Location - Noise Monitoring Results								
B1	66	64	67	69	N	66	Plant Noise	N/A
B2	51	50	52	56	N	51	Plant Noise	N/A
B3	52	36	41	76	N	52	Plant Noise	N/A
B4	36	35	37	46	N	36	Plant Noise	N/A
B5	30	27	30	57	N	30	Plant Noise	N/A
B6	51	50	52	56	N	51	Plant Noise	N/A
B7	30	28	36	44	N	30	Plant Noise	N/A
B8	36	28	32	70	N	36	Plant Noise	N/A
B9	53	45	55	68	N	53	Plant Noise	N/A

## 4. Summary of Noise Survey

A summary of the noise monitoring measurements taken at the Noise Sensitive Locations and Boundary Locations are presented below:

### 4.1 Noise Sensitive Locations

RUSAL Aughinish's IPPC Licence Daytime noise limit of 55 dB ( $L_{Aeq}$ ) was not exceeded at any of the Noise Sensitive Locations.

RUSAL Aughinish's IPPC Licence Night time noise limit of 45 dB ( $L_{Aeq}$ ) was not exceeded at any of the Noise Sensitive Locations with the exception of NSL2 and NSL4 which marginally exceeded the limit with a monitored measurement of 46 dB for both.

However noise emanating from RUSAL Aughinish at these locations during the survey was barely perceptible. The NG4 Guidelines states that *“for some noise surveys, the  $L_{AF90,T}$  index may be used to give a good indication of the actual noise output from the site, where the noise emissions on site are relatively steady and extraneous noises may unduly influence the measured  $L_{Aeq,T}$ ”*. A review of the data obtained during the survey shows that the  $L_{A90}$  monitored values, which are representative of background noise, to be significantly below the limit values. It can therefore be concluded that RUSAL Aughinish are in compliance with the Licence limits.

There was no tonal or impulsive component in the noise detected (subjectively or measured) emanating from the facility at any of the monitoring locations.

### 4.2 Boundary Locations

Boundary noise monitoring results reflect the nature and scale of operations taking place close to these areas and were directly related to plant operations. The daytime  $L_{Aeq}$  recorded at the boundary locations ranged from 42 dB at boundary location B5 to 56 dB at boundary location B2. The night time  $L_{Aeq}$  recorded at the boundary locations ranged from 30 dB at boundary location B5 to 66 dB at boundary location B1 (the Jetty).

Noise emissions from the RUSAL Aughinish facility include contributions from the operation of the process plant and equipment within the installation, together with vehicular movements both within and outside the site.

The position of the Boundary Locations are however sufficiently removed from the noise sensitive areas to cause disturbance and therefore unlikely to be a nuisance.

## **5. Conclusions**

Based on the noise monitoring undertaken at RUSAL Aughinish the following can be concluded:

- The daytime noise limit was complied with at all noise sensitive locations.
- The night-time noise limit was complied with at all noise sensitive locations.
- There was no audible or measurable tonal or impulsive component in the noise at the noise sensitive locations.

## **6. References**

'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)' as published by the Environmental Protection Agency in April 2012.

ISO 1996: Acoustics - Description and Measurement of Environmental Noise

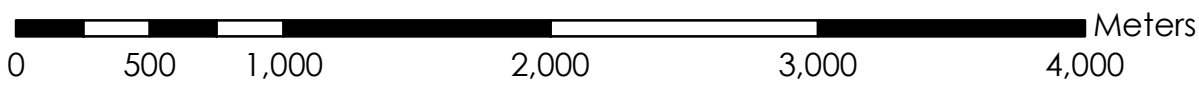
# Attachment A Noise Monitoring Locations






**Legend**

- Noise Sensitive Locations (NSL)
- Boundary Locations (B)



 <small>Energy, Environment &amp; Safety</small>		OES Consulting 2nd Floor FBD House Fels Point Tralee Co Kerry
<b>Client:</b>	RUSAL Aughinish	
<b>Project:</b>	Annual Noise Survey	
<b>Map Title:</b>	Noise Monitoring Locations	
<b>OES Ref:</b>	F1_1017_21	
<b>Revision:</b>	01	
<b>Document Control:</b>	Drawn By: TQ Checked By: EO'L Date: 23/09/2010	

# Attachment B Certificates of Calibration

# Certificate of Calibration



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## Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Sound Level Meter
Model Number	CR:171B
Serial Number	G056143

---

## Calibration Procedure

The instrument detailed above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

---

## Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. Which are traceable to the appropriate International Standards.

The Cirrus Research plc calibration laboratory standards are:

Microphone Type	B&K4180	Serial Number	1893453	Calibration Ref.	S 6009
Pistonphone Type	B&K4220	Serial Number	613843	Calibration Ref.	S 5964

---

Calibrated by

Calibration Date

11 January 2012

Calibration Certificate Number

193395

This Calibration Certificate is valid for 12 months from the date above.

# Certificate of Calibration



## Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Acoustic Calibrator
Model Number	CR:515
Serial Number	55191

## Calibration Procedure

The acoustic calibrator detailed above has been calibrated to the published data as described in the operating manual. The procedures and techniques used to follow the recommendations of the IEC standard Electroacoustics – Sound Calibrators IEC 60942:2003, IEC 60942:1997, BS EN 60942:1998 and BS EN 60942:2003 where applicable.. The calibrator's main output is 94.00 dB (1 Pa) and this was set within the 0.01 dB resolution of the test system, i.e. one hundredth of a decibel. Numbers in {parenthesis} refer to the paragraph in IEC 60942.

## Calibration Traceability

The calibrator above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	B&K4180	Serial Number	1893453	Calibration Ref.	S 6009
Pistonphone Type	B&K4220	Serial Number	613843	Calibration Ref.	S 5964

## Calibration Climate Conditions

The climatic test conditions were all maintained within the permitted limits of IEC 60942:1997.

Temperature	{B.3.2}	Permitted band	15°C to 25°C
Humidity	{B.3.2}	Permitted band	30% to 90% RH
Static Pressure	{B.3.2}	Permitted band	85 kPa to 105 kPa
Ambient Noise Level	{B.3.3.6}	Max permitted level	64 dB(Z)

## Measurement Results

The figures below are the Calibration Laboratory test limits for this model calibrator and have a smaller tolerance than those permitted in IEC 60942.

94 dB Output	94.01	dB	Permitted band	93.95 to 94.05dB
Frequency	1000	Hz	Permitted band	990 to 1010Hz

## Uncertainty

With an uncertainty coefficient of k=2, i.e. a 95% confidence level, the uncertainty of each measure is

94 dB Output	± 0.13 dB	104 dB Output	± 0.14 dB
Frequency	± 0.1 Hz	Level Stability	± 0.04 dB

Calibrated by

Calibration Date 11 January 2012

Calibration Certificate Number 193396

This Calibration Certificate is valid for 12 months from the date above.

# Attachment C Noise Monitoring Report Sheets



## Measurement Summary Report

Name NSL 1\_Day #1 (1587)  
 Time 09/07/2012 13:17:44  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

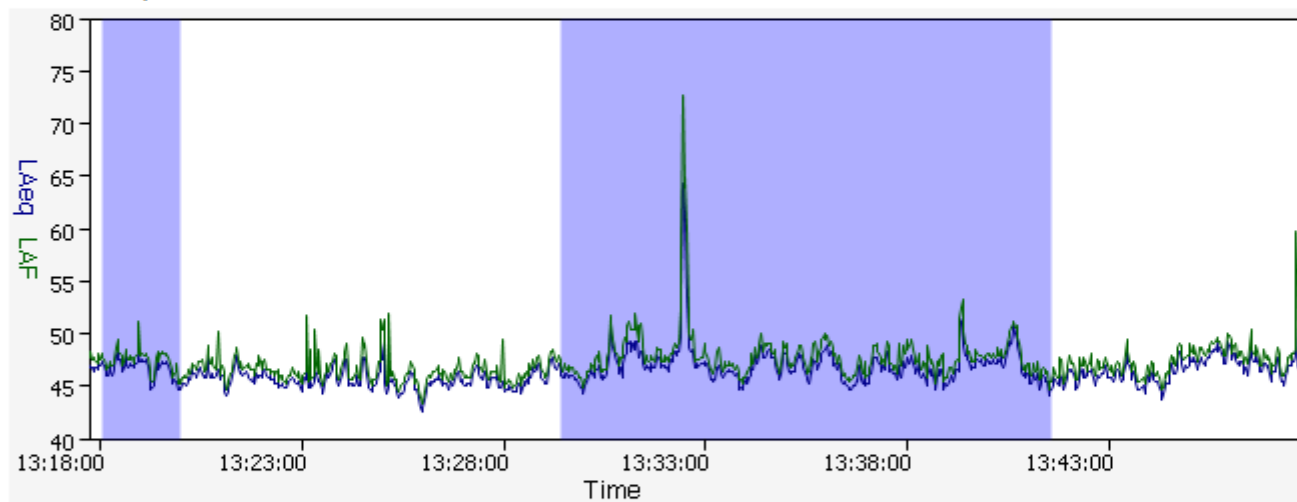
**Summary**  
 LAeq 47.1 dB  
 LAE 79.7 dB  
 LAFMax 72.7 dB

LAF1 50.6 dB  
 LAF5 48.5 dB  
 LAF10 48.0 dB  
 LAF50 46.2 dB  
 LAF90 44.8 dB  
 LAF95 44.5 dB  
 LAF99 43.9 dB

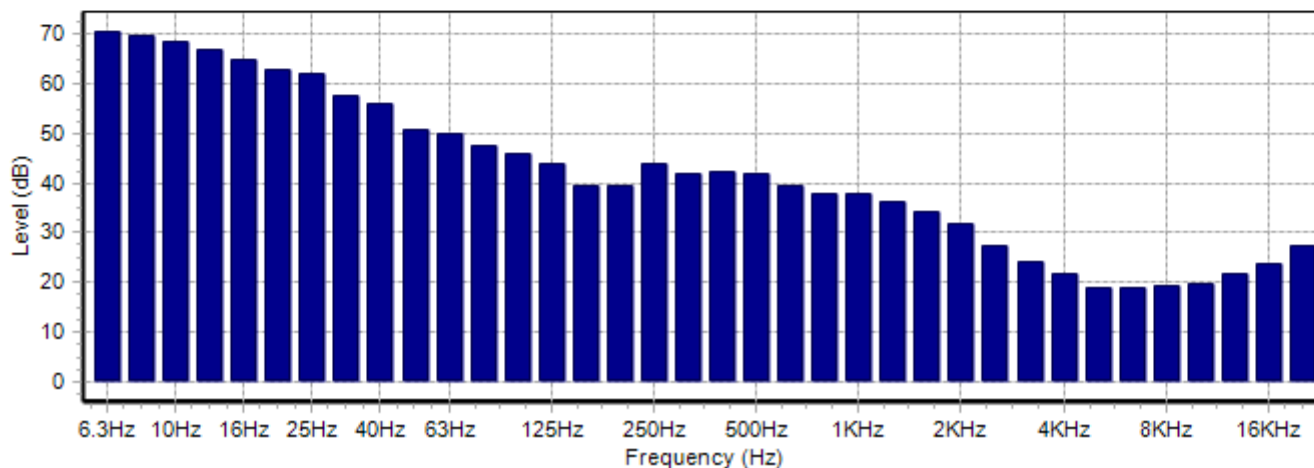
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL1\_Day #2 (1592)  
 Time 09/07/2012 16:25:48  
 Duration 00:28:24  
 Instrument GO56143, CR:171B

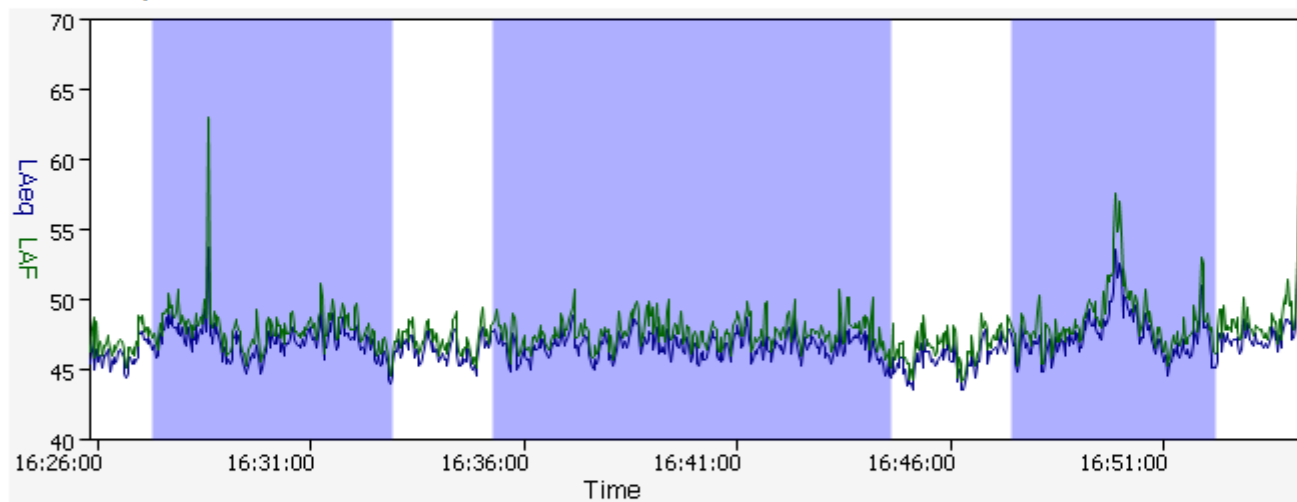
**Summary**  
 LAeq 46.9 dB  
 LAE 79.2 dB  
 LAFMax 62.9 dB

LAF1 50.5 dB  
 LAF5 48.7 dB  
 LAF10 48.1 dB  
 LAF50 46.6 dB  
 LAF90 45.1 dB  
 LAF95 44.7 dB  
 LAF99 44.0 dB

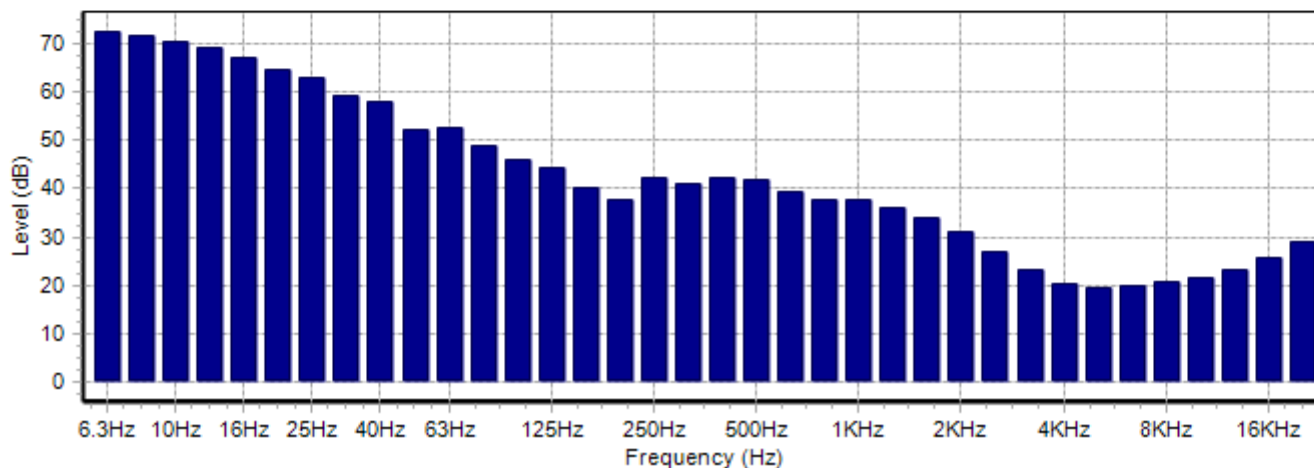
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





## Measurement Summary Report

Name NSL 1\_Day #3 (1111)  
 Time 21/08/2012 15:06:25  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

### Summary

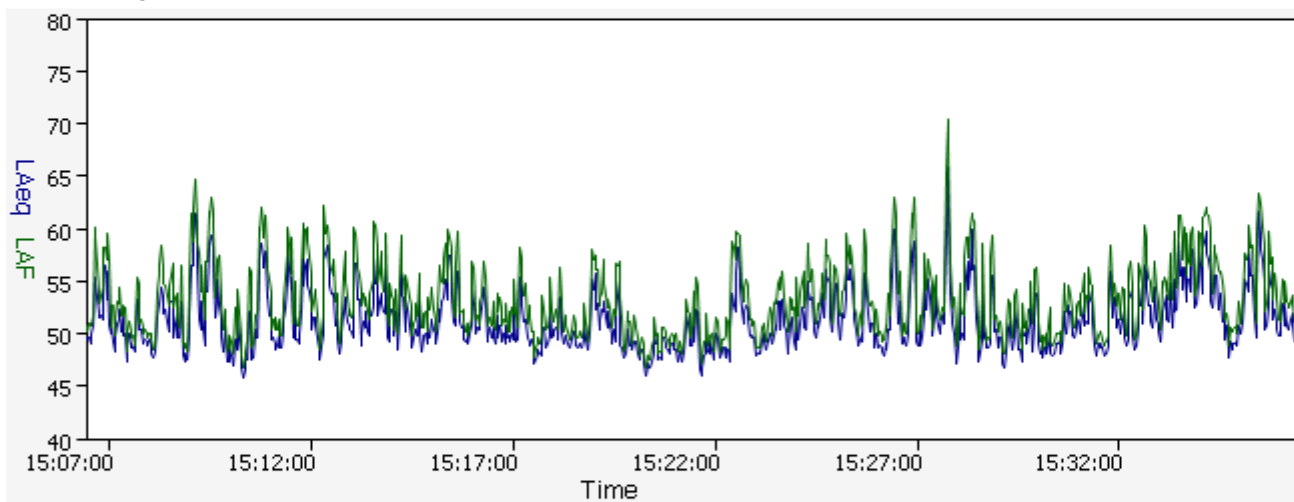
LAeq 52.5 dB  
 LAE 85.0 dB  
 LAFMax 70.3 dB

LAF1 59.9 dB  
 LAF5 57.0 dB  
 LAF10 55.3 dB  
 LAF50 50.3 dB  
 LAF90 48.0 dB  
 LAF95 47.5 dB  
 LAF99 46.5 dB

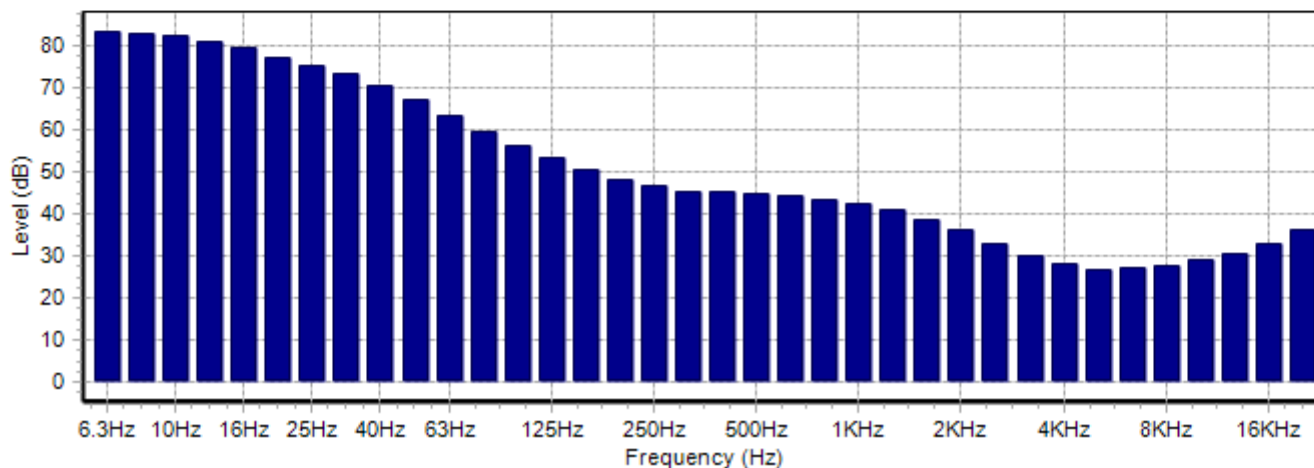
### Calibration Information

21/08/2012 15:04:22 0.56 dB  
 22/08/2012 22:09:10 0.39 dB

Time History



Frequency Bands





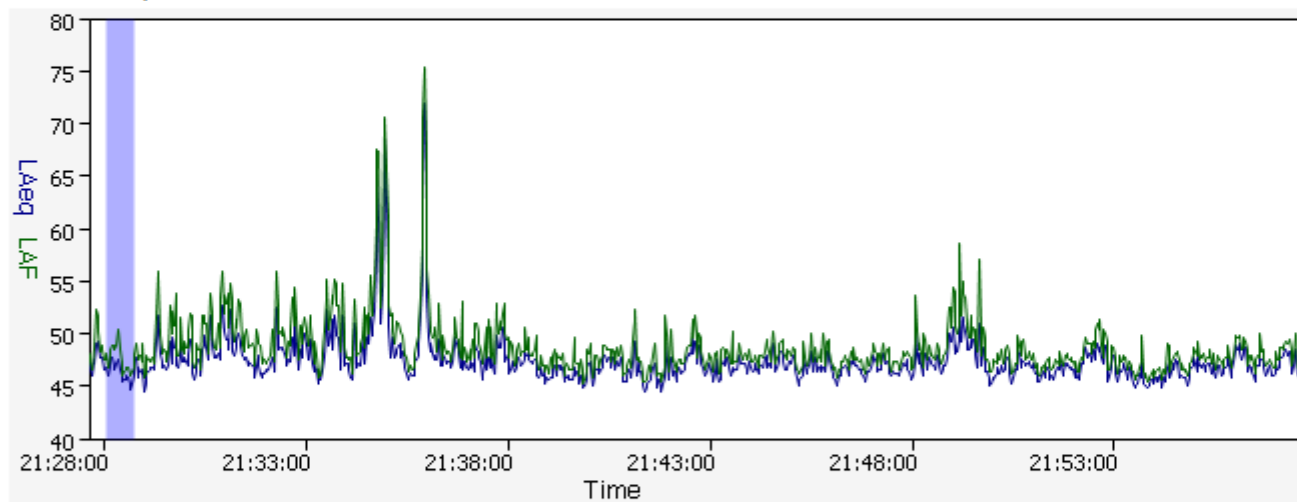
## Measurement Summary Report

Name	NSL 1_Evening (1600)	<b>Summary</b>	LAF1	56.2 dB	
Time	09/07/2012 21:27:37	LAeq	49.9 dB	LAF5	50.3 dB
Duration	00:30:00	LAE	82.4 dB	LAF10	49.1 dB
Instrument	GO56143, CR:171B	LAFMax	75.3 dB	LAF50	46.9 dB
				LAF90	45.5 dB
				LAF95	45.2 dB
				LAF99	44.6 dB

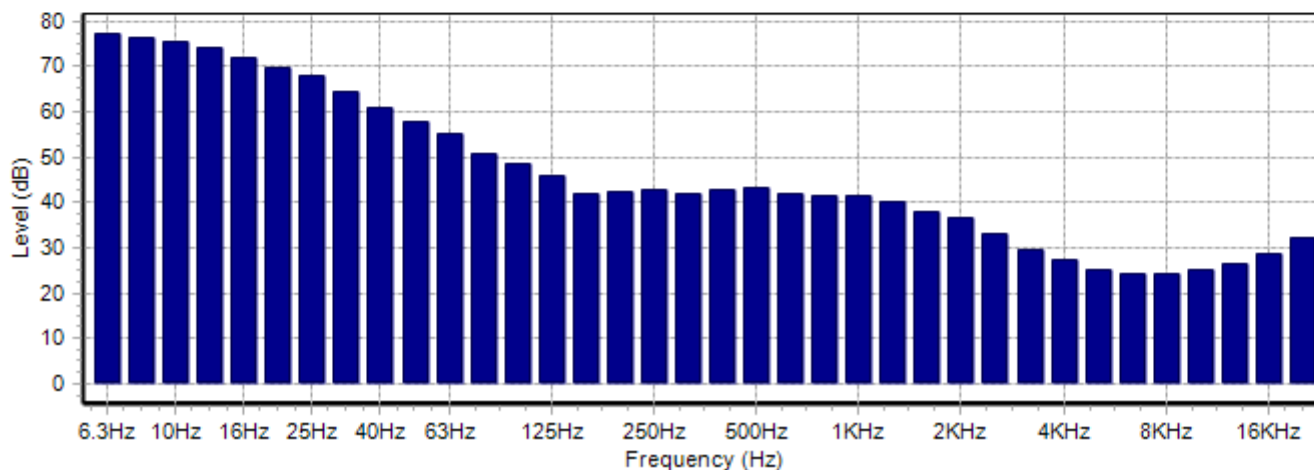
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





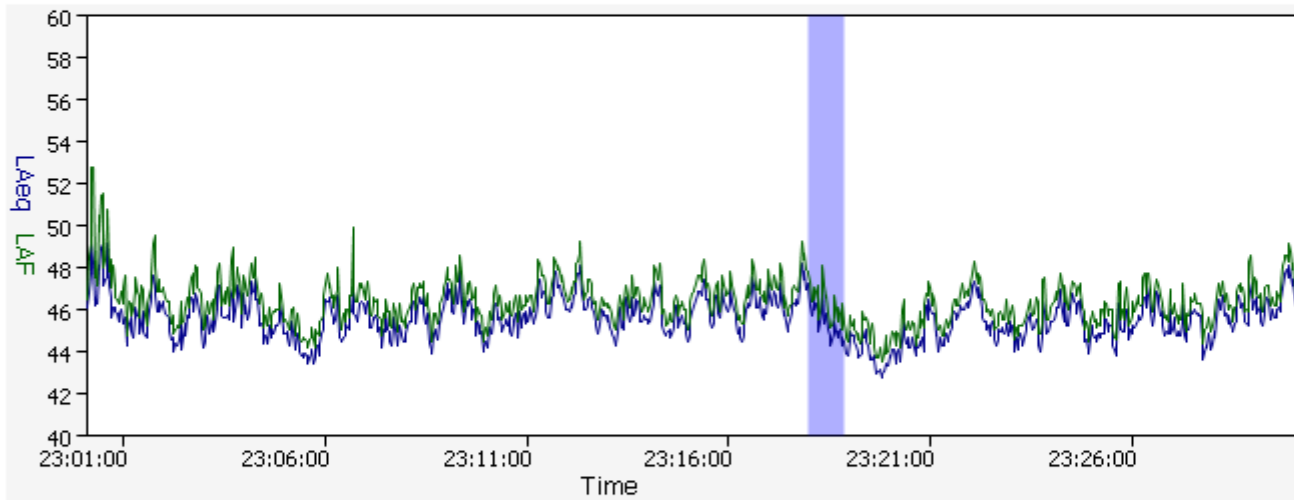
### Measurement Summary Report

Name	NSL 1_Night #1 (1601)	<b>Summary</b>	LAF1	48.0 dB	
Time	09/07/2012 23:00:05	LAeq	45.6 dB	LAF5	47.2 dB
Duration	00:30:00	LAE	78.2 dB	LAF10	46.8 dB
Instrument	GO56143, CR:171B	LAFMax	52.7 dB	LAF50	45.4 dB
				LAF90	44.1 dB
				LAF95	43.8 dB
				LAF99	43.1 dB

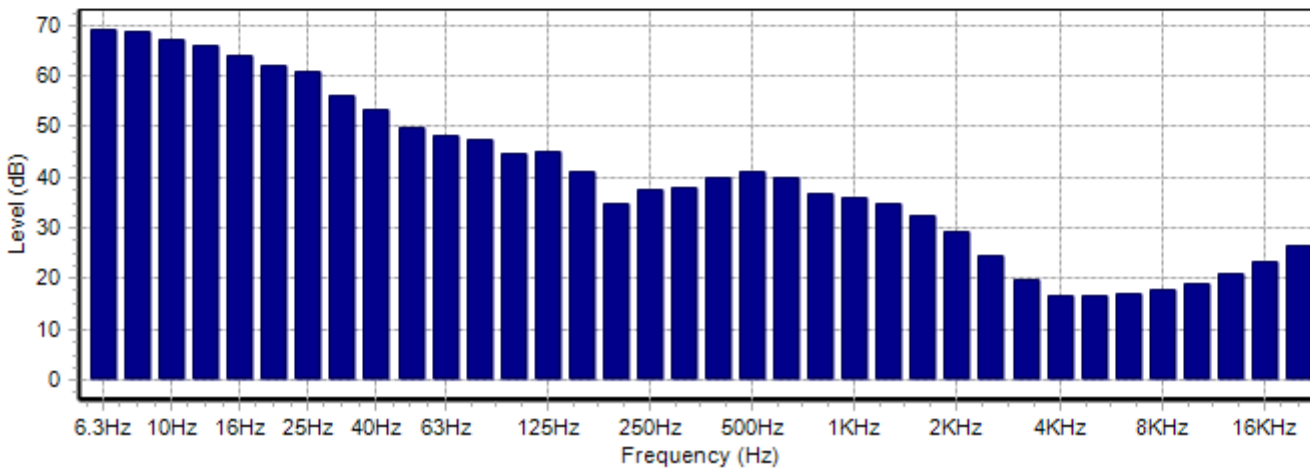
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





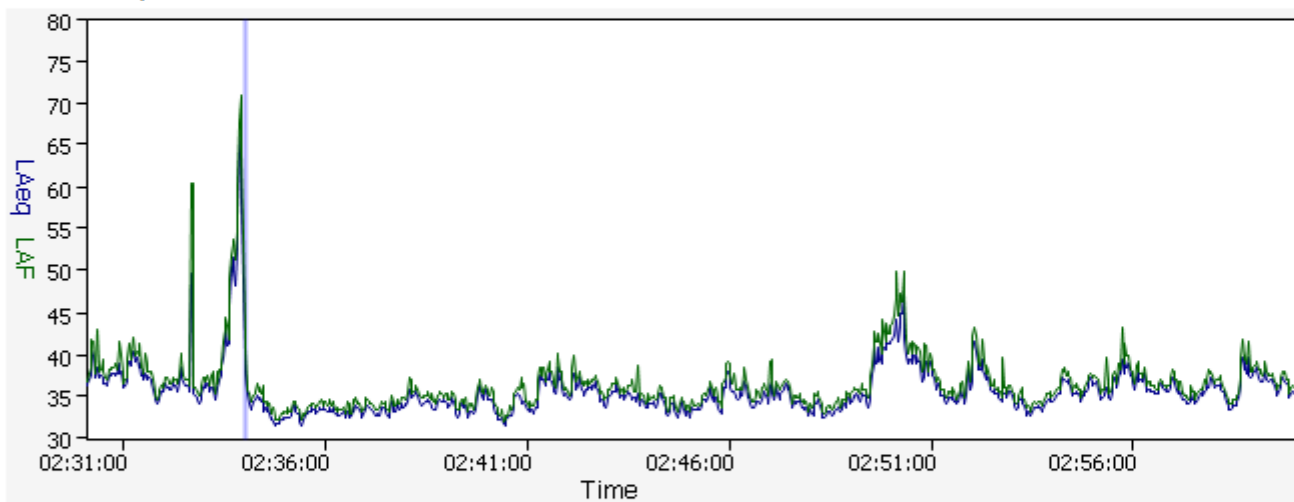
## Measurement Summary Report

Name	NSL 1_Night #2 (1607)	<b>Summary</b>	LAF1	48.2 dB	
Time	10/07/2012 02:30:04	LAeq	41.8 dB	LAF5	39.7 dB
Duration	00:30:00	LAE	74.4 dB	LAF10	38.2 dB
Instrument	GO56143, CR:171B	LAFMax	70.7 dB	LAF50	35.0 dB
				LAF90	33.0 dB
				LAF95	32.6 dB
				LAF99	31.9 dB

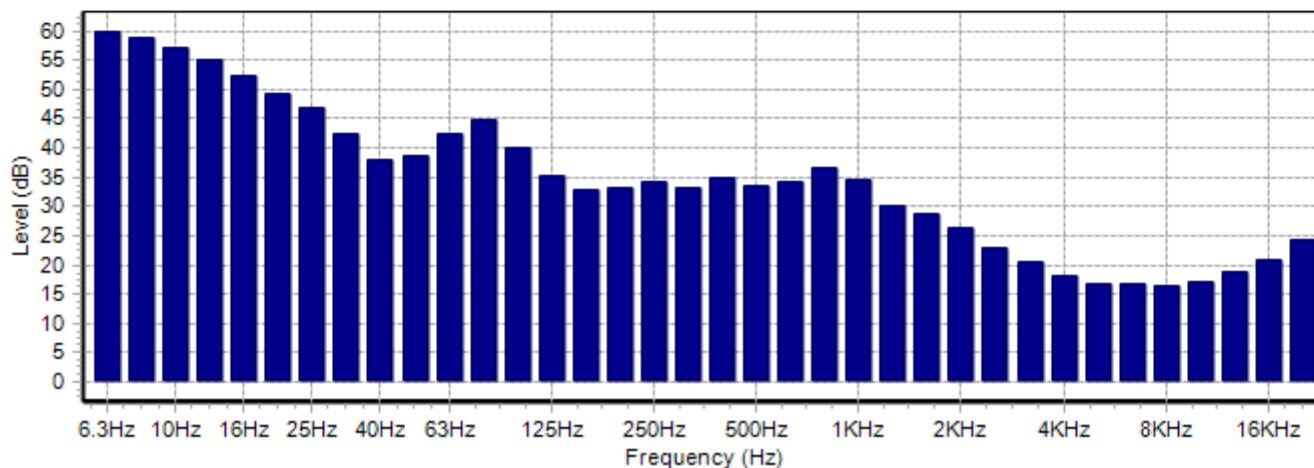
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 2\_Day #1 (1588)  
 Time 09/07/2012 13:54:48  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

**Summary**

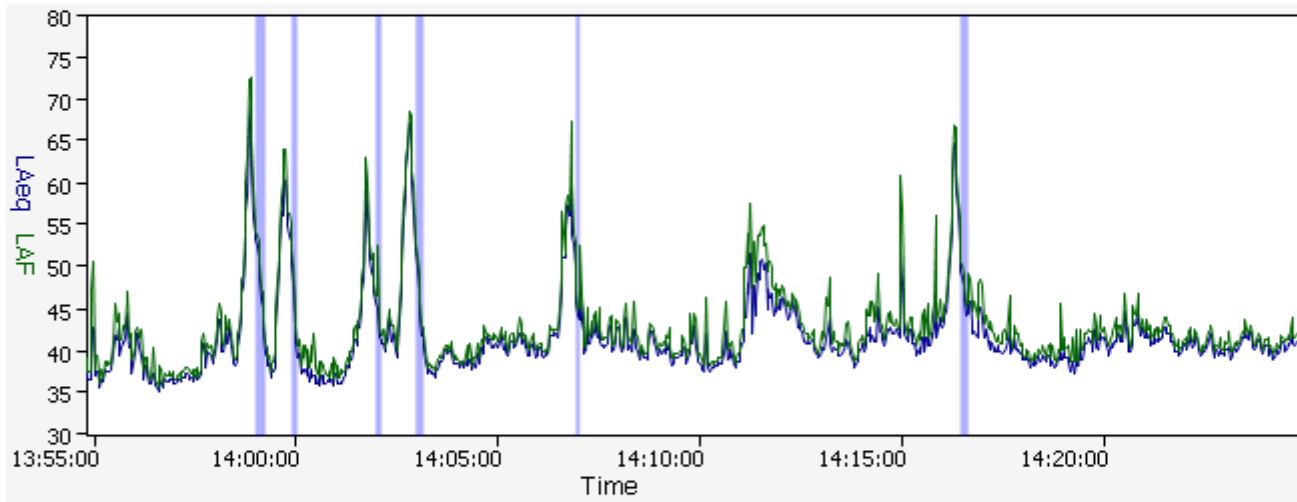
LAeq 48.5 dB  
 LAE 81.1 dB  
 LAFMax 72.4 dB

LAF1 61.4 dB  
 LAF5 51.9 dB  
 LAF10 46.3 dB  
 LAF50 40.4 dB  
 LAF90 37.3 dB  
 LAF95 36.5 dB  
 LAF99 35.7 dB

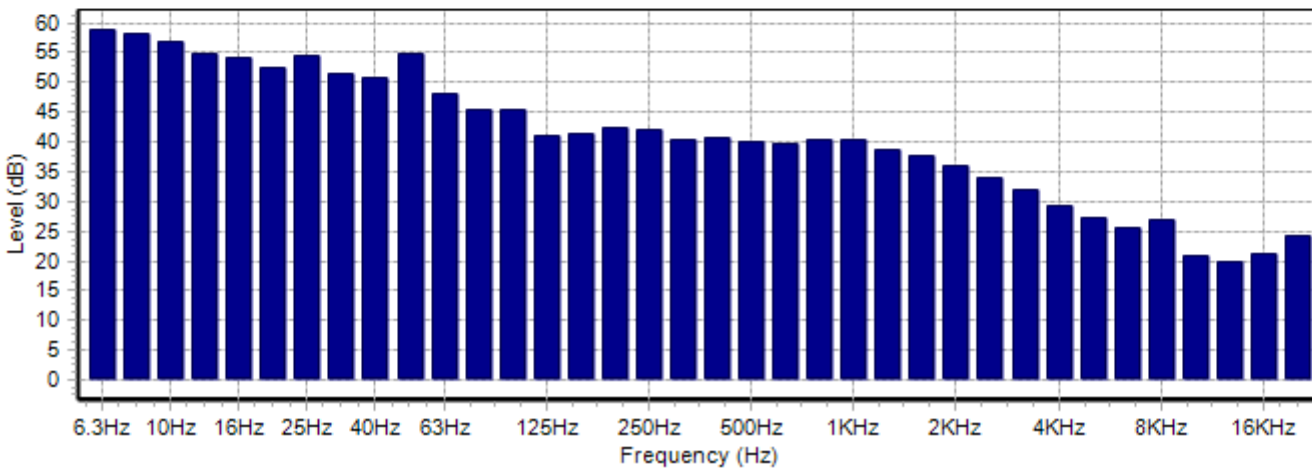
**Calibration Information**

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





## Measurement Summary Report

Name NSL 2\_Day #2 (1593)  
 Time 09/07/2012 17:05:21  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

### Summary

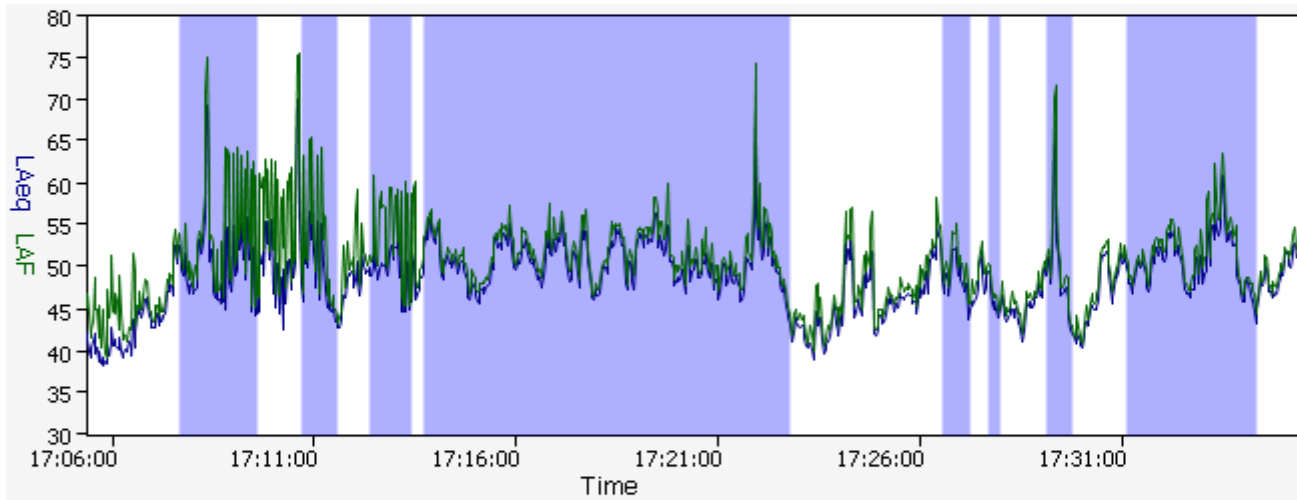
LAeq 51.8 dB  
 LAE 84.4 dB  
 LAFMax 75.3 dB

LAF1 59.3 dB  
 LAF5 54.6 dB  
 LAF10 53.3 dB  
 LAF50 48.4 dB  
 LAF90 42.9 dB  
 LAF95 41.0 dB  
 LAF99 38.6 dB

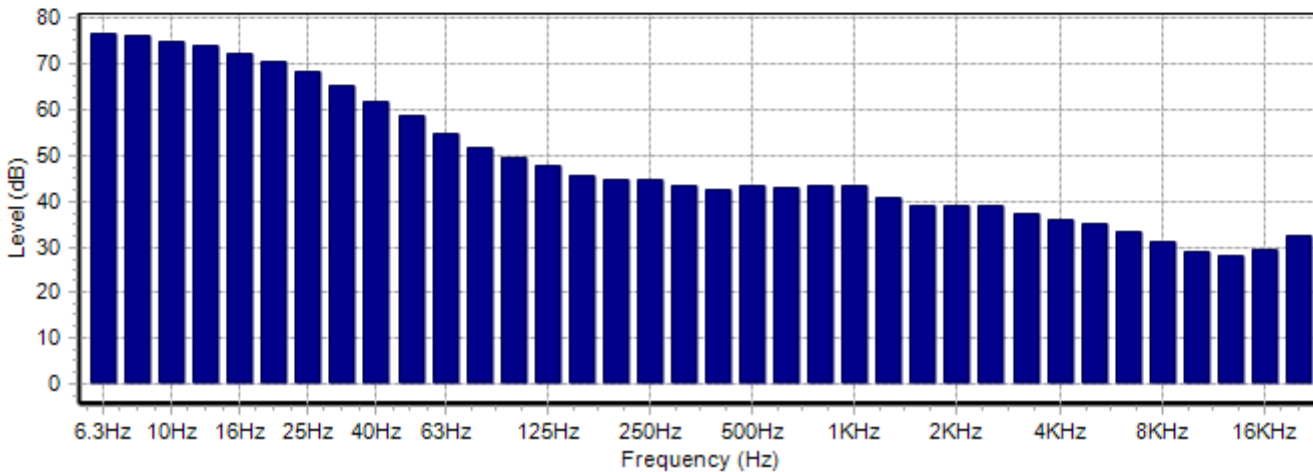
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





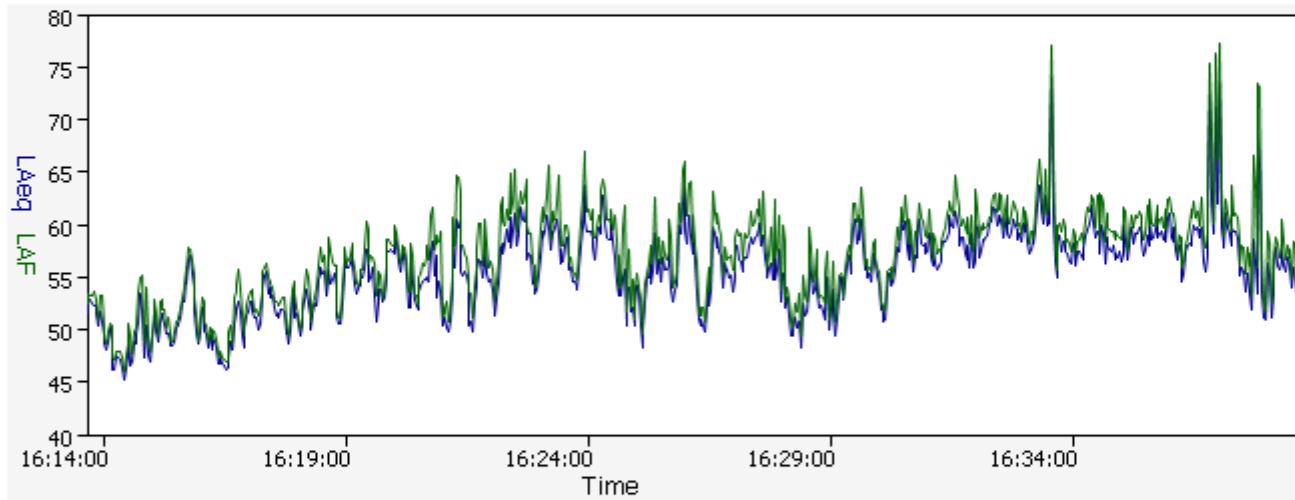
### Measurement Summary Report

Name	NSL 2_Day#3 (1113)	<b>Summary</b>	LAF1	64.2 dB
Time	21/08/2012 16:13:38	LAeq	LAF5	61.0 dB
Duration	00:25:02	LAE	LAF10	60.0 dB
Instrument	GO56143, CR:171B	LAFMax	LAF50	55.7 dB
			LAF90	49.8 dB
			LAF95	48.5 dB
			LAF99	46.4 dB

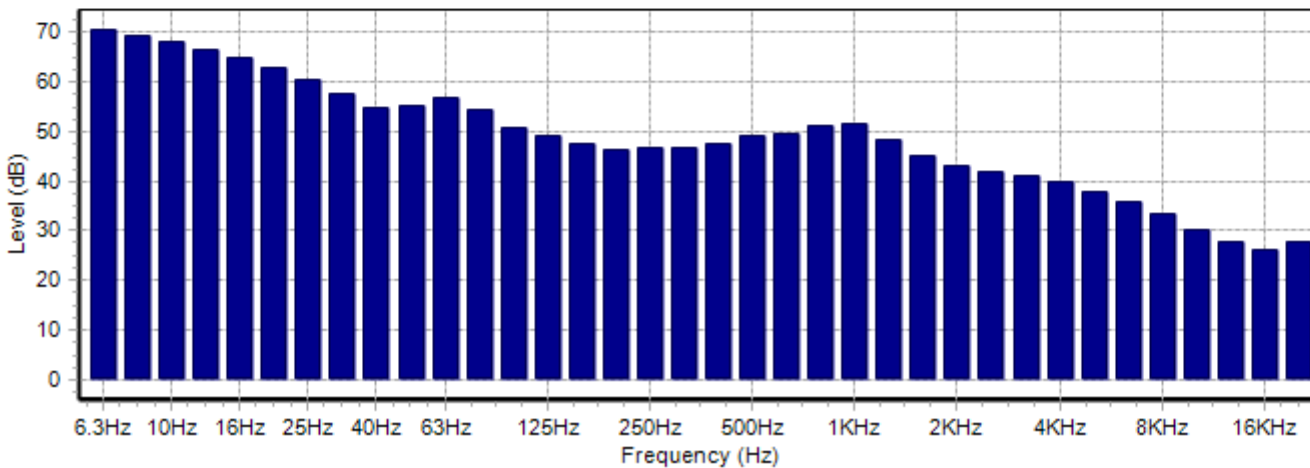
### Calibration Information

21/08/2012 15:04:22 0.56 dB  
 22/08/2012 22:09:10 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 2\_Evening (1599)  
 Time 09/07/2012 20:48:06  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

#### Summary

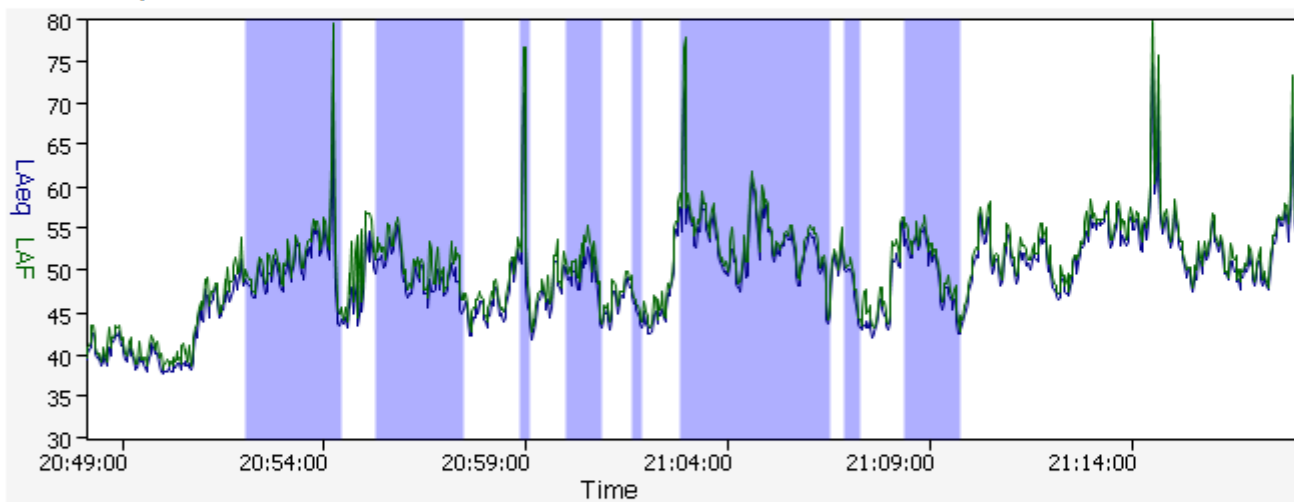
LAeq 54.6 dB  
 LAE 87.2 dB  
 LAFMax 79.7 dB

LAF1 61.2 dB  
 LAF5 56.4 dB  
 LAF10 55.2 dB  
 LAF50 49.6 dB  
 LAF90 42.4 dB  
 LAF95 39.4 dB  
 LAF99 38.1 dB

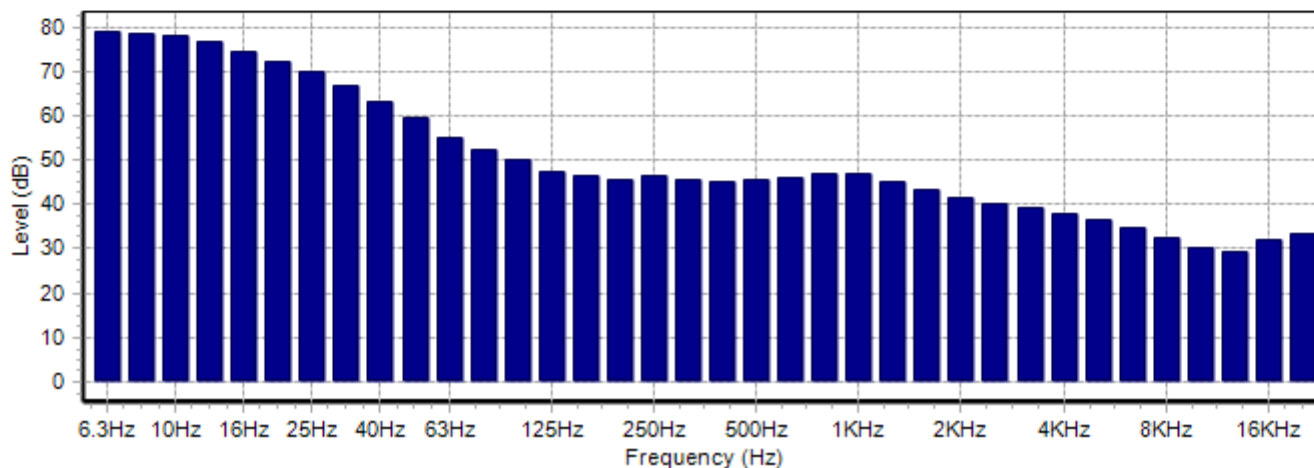
#### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





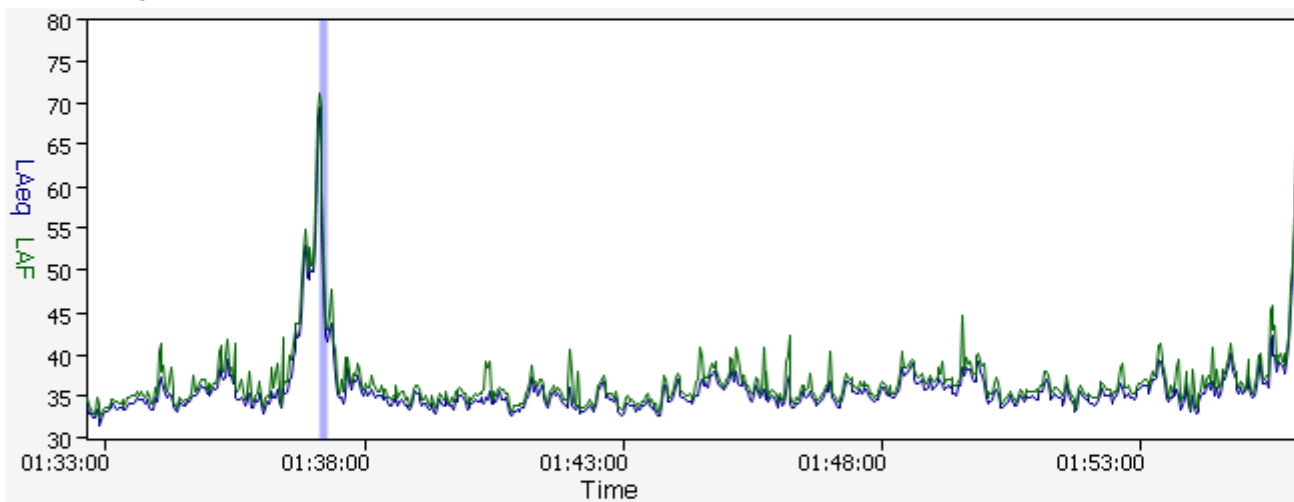
### Measurement Summary Report

Name	NSL 2_Night#1 (1605)	<b>Summary</b>	LAF1	51.5 dB	
Time	10/07/2012 01:32:37	LAeq	44.4 dB	LAF5	39.7 dB
Duration	00:23:25	LAE	75.9 dB	LAF10	37.8 dB
Instrument	GO56143, CR:171B	LAFMax	71.0 dB	LAF50	35.0 dB
				LAF90	33.5 dB
				LAF95	33.2 dB
				LAF99	32.6 dB

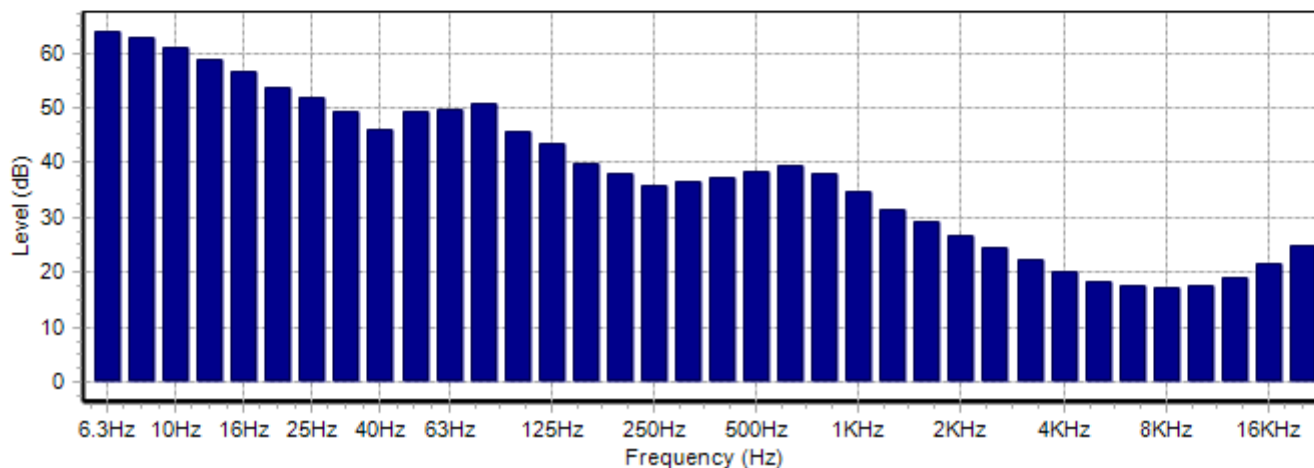
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





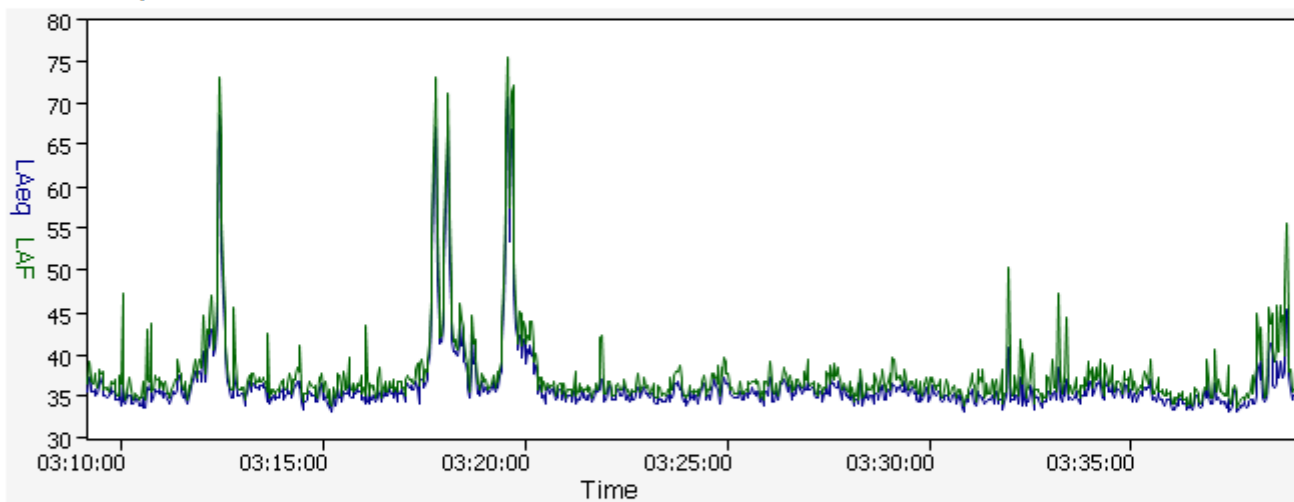
### Measurement Summary Report

Name	NSL 2_Night #2 (1126)	<b>Summary</b>	LAF1	59.1 dB	
Time	23/08/2012 03:09:07	LAeq	47.6 dB	LAF5	41.5 dB
Duration	00:30:00	LAE	80.2 dB	LAF10	37.9 dB
Instrument	GO56143, CR:171B	LAFMax	75.3 dB	LAF50	35.2 dB
				LAF90	34.1 dB
				LAF95	33.8 dB
				LAF99	33.2 dB

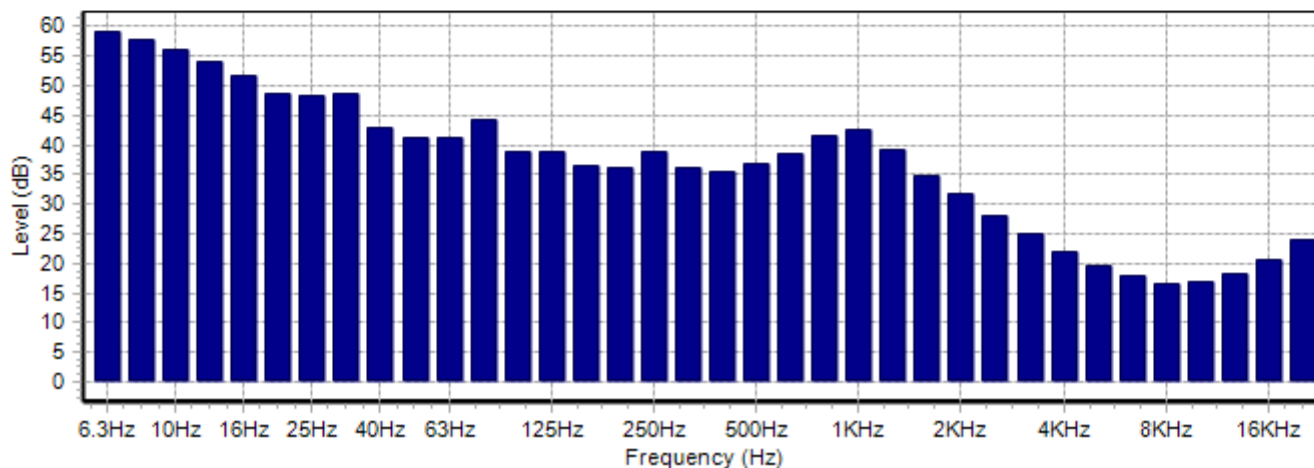
### Calibration Information

22/08/2012 22:09:10 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 3\_Day #1 (1590)  
 Time 09/07/2012 15:08:16  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

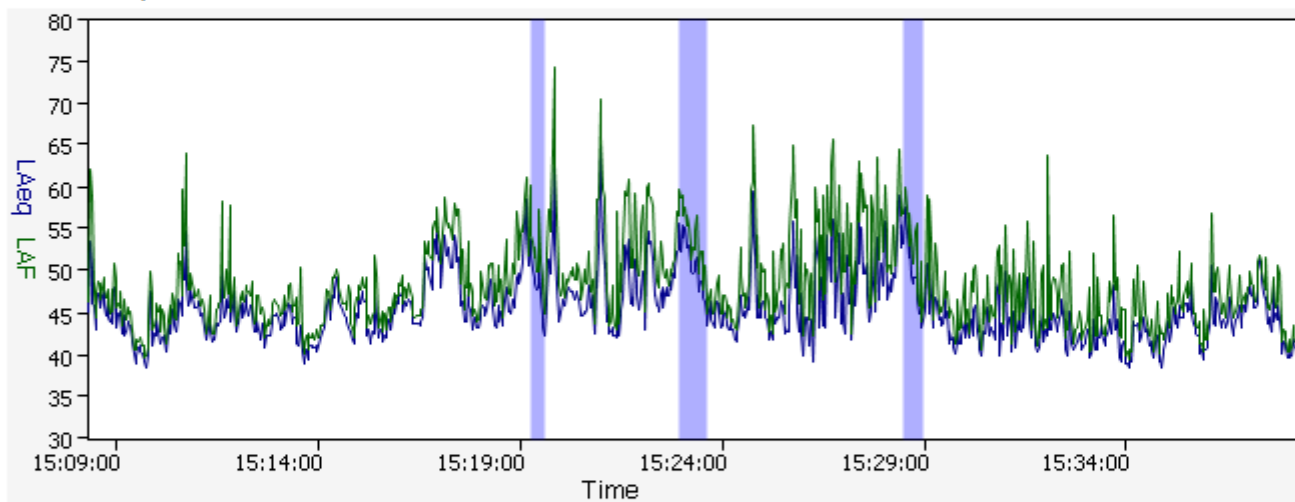
**Summary**  
 LAeq 48.0 dB  
 LAE 80.5 dB  
 LAFMax 74.1 dB

LAF1 57.8 dB  
 LAF5 52.8 dB  
 LAF10 50.1 dB  
 LAF50 44.2 dB  
 LAF90 40.7 dB  
 LAF95 39.8 dB  
 LAF99 38.6 dB

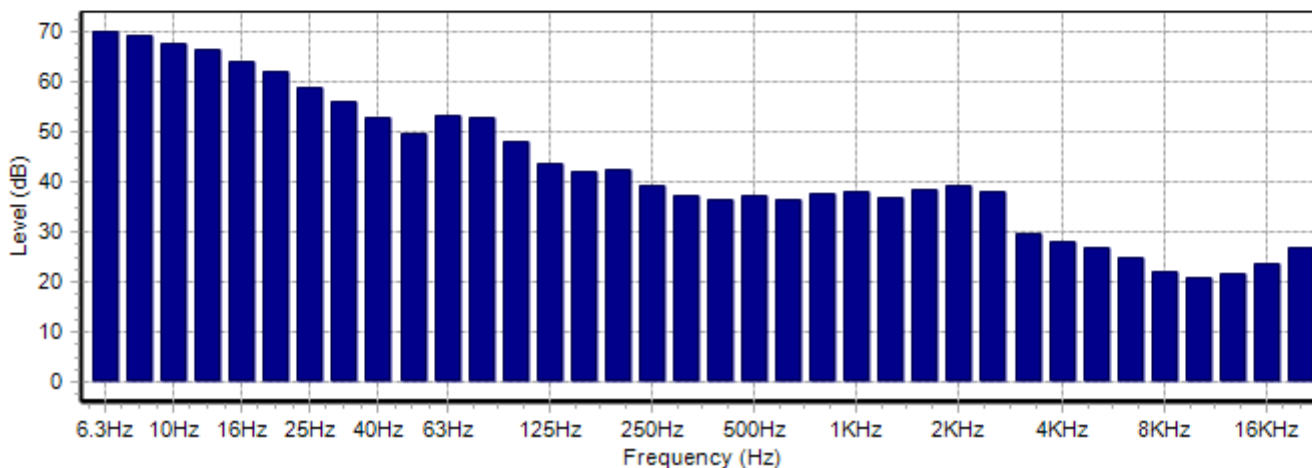
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 3\_Day #2 (1097)  
 Time 21/08/2012 10:14:14  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

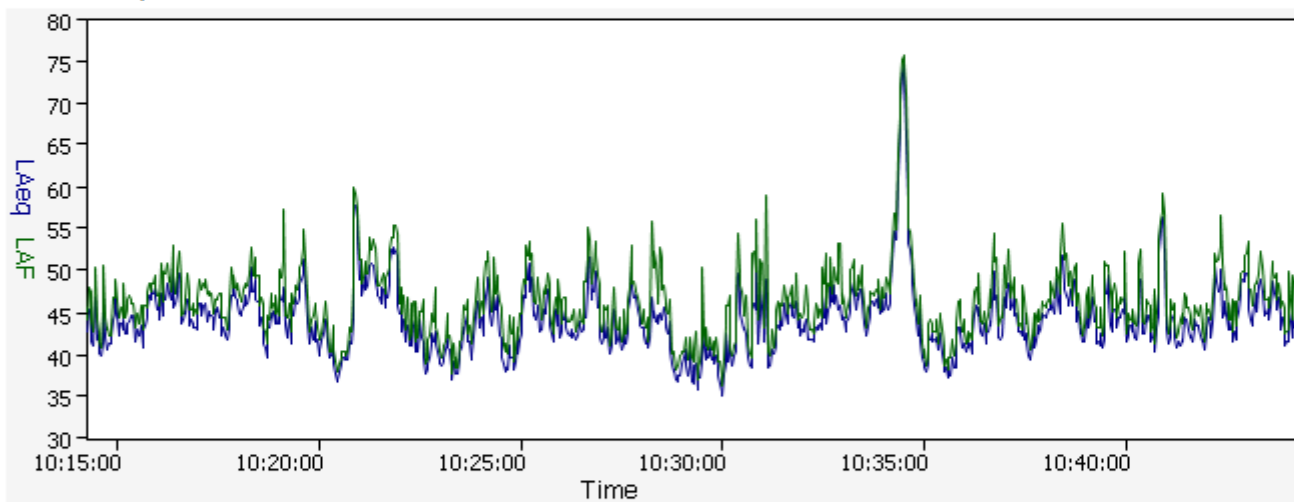
**Summary**  
 LAeq 51.4 dB  
 LAE 83.9 dB  
 LAFMax 75.6 dB

LAF1 56.9 dB  
 LAF5 50.3 dB  
 LAF10 48.3 dB  
 LAF50 43.5 dB  
 LAF90 39.4 dB  
 LAF95 38.2 dB  
 LAF99 36.6 dB

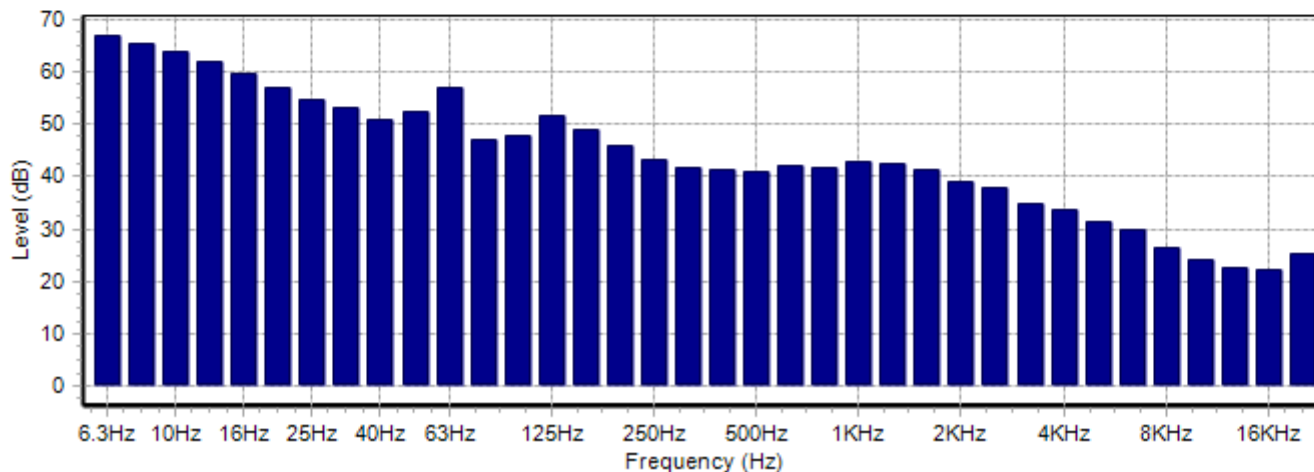
### Calibration Information

21/08/2012 10:10:15 -0.30 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 3\_Day #3 (1112)  
 Time 21/08/2012 15:38:22  
 Duration 00:29:02  
 Instrument GO56143, CR:171B

**Summary**

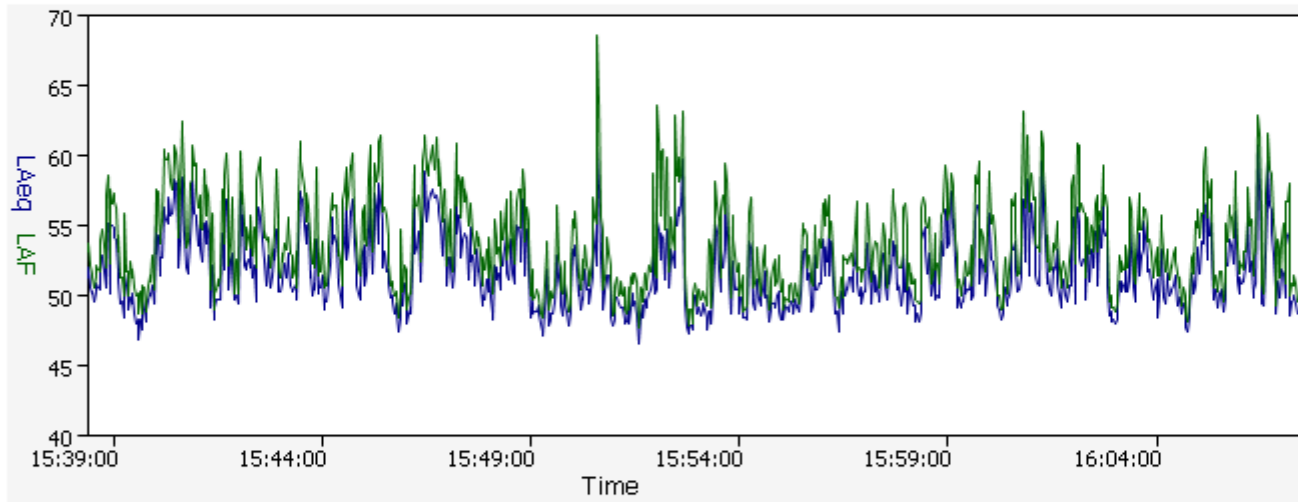
LAeq 52.5 dB  
 LAE 84.9 dB  
 LAFMax 68.6 dB

LAF1 59.2 dB  
 LAF5 56.8 dB  
 LAF10 55.4 dB  
 LAF50 50.8 dB  
 LAF90 48.4 dB  
 LAF95 48.0 dB  
 LAF99 47.1 dB

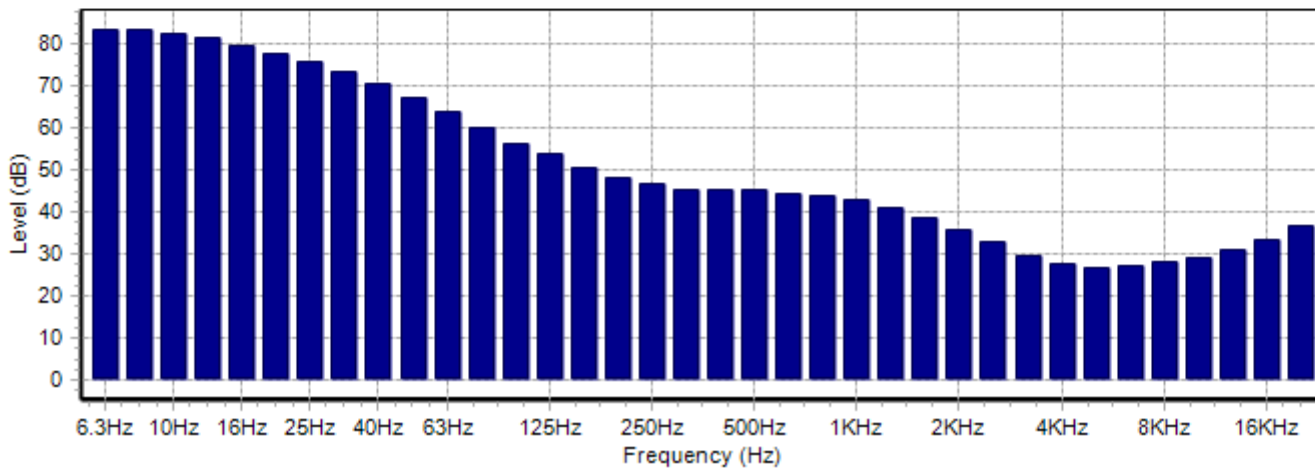
**Calibration Information**

21/08/2012 15:04:22 0.56 dB  
 22/08/2012 22:09:10 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 3\_Evening (1597)  
 Time 09/07/2012 19:41:55  
 Duration 00:26:26  
 Instrument GO56143, CR:171B

#### Summary

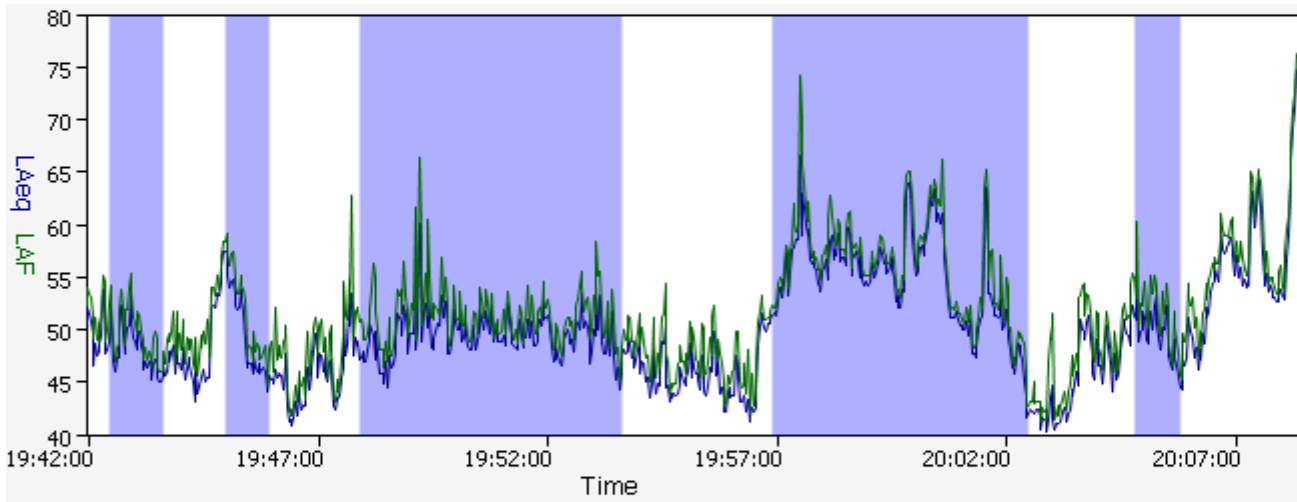
LAeq 54.4 dB  
 LAE 86.4 dB  
 LAFMax 76.3 dB

LAF1 64.1 dB  
 LAF5 59.0 dB  
 LAF10 56.9 dB  
 LAF50 49.1 dB  
 LAF90 43.8 dB  
 LAF95 42.4 dB  
 LAF99 40.8 dB

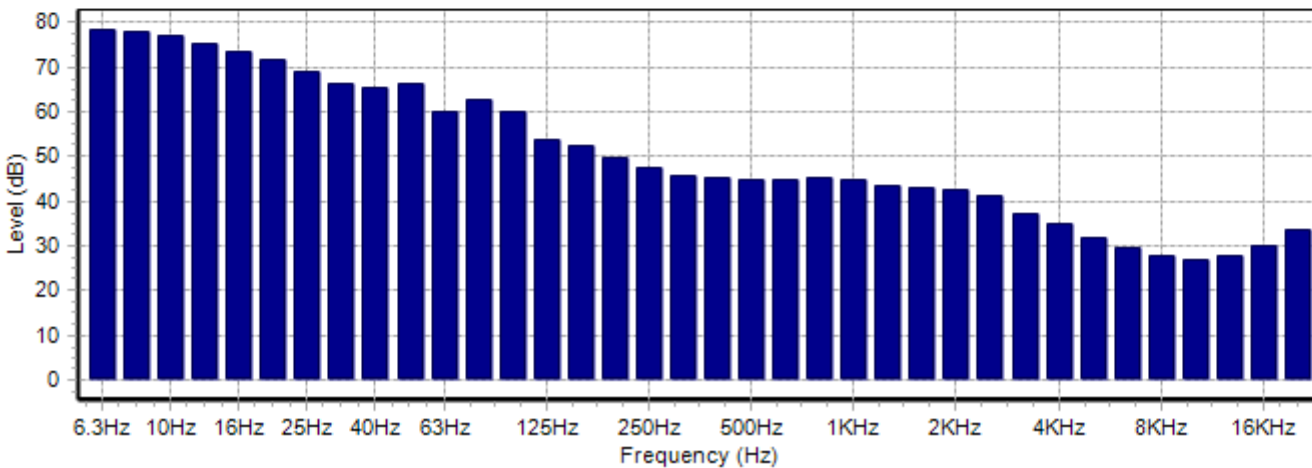
#### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





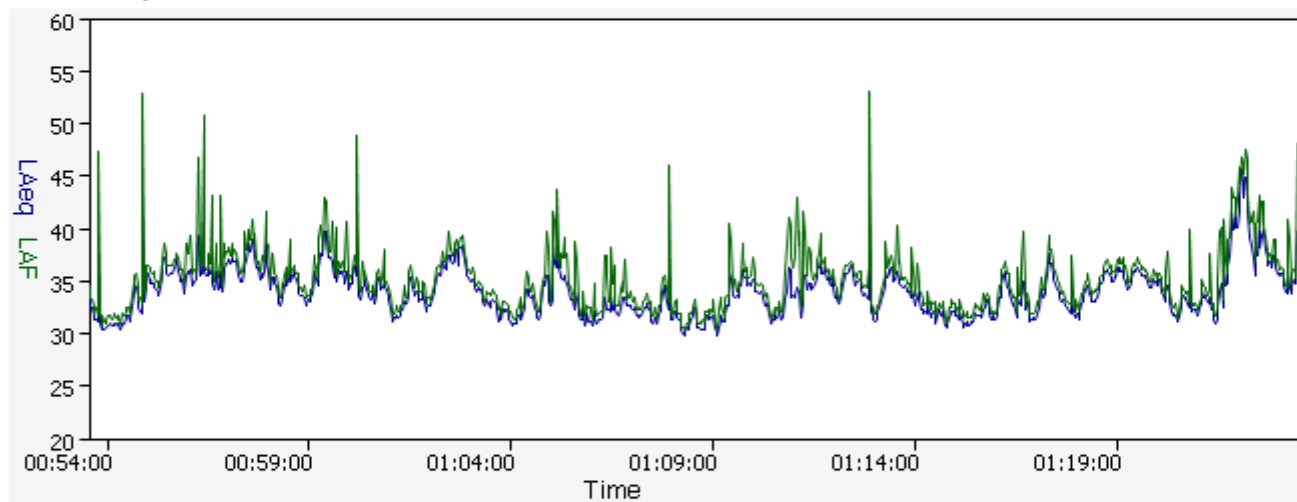
## Measurement Summary Report

Name	NSL 3_Night #1 (1604)	<b>Summary</b>	LAF1	41.8 dB	
Time	10/07/2012 00:53:33	LAeq	34.8 dB	LAF5	37.7 dB
Duration	00:30:00	LAE	67.3 dB	LAF10	36.6 dB
Instrument	GO56143, CR:171B	LAFMax	53.0 dB	LAF50	33.7 dB
				LAF90	31.2 dB
				LAF95	30.8 dB
				LAF99	30.2 dB

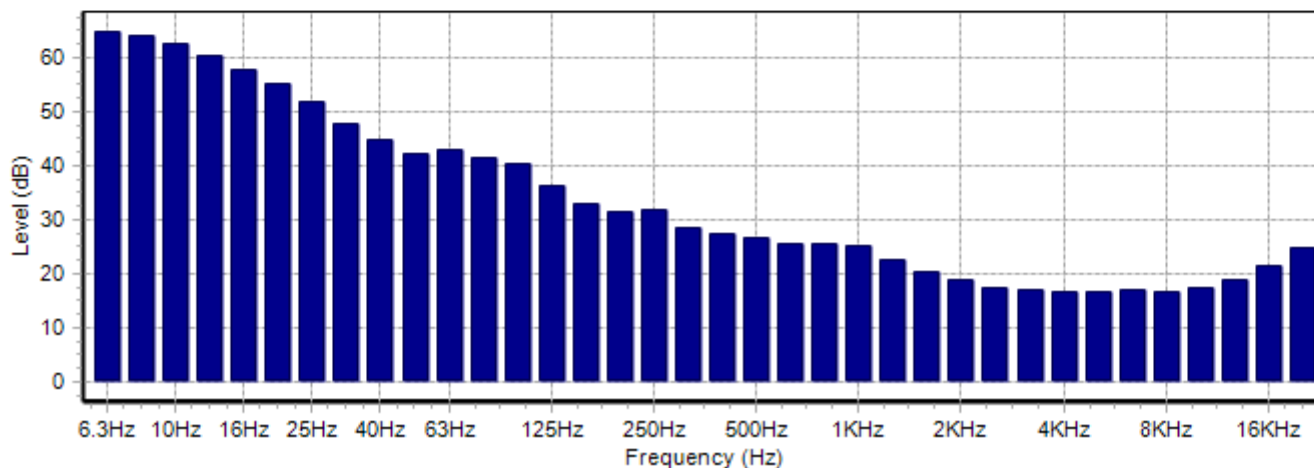
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





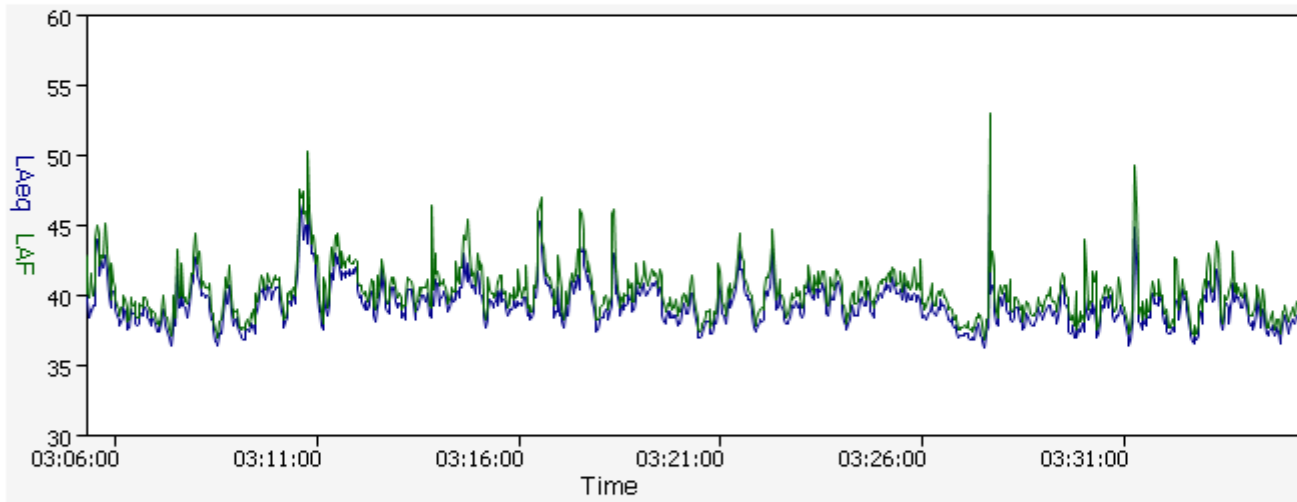
### Measurement Summary Report

Name	NSL 3_Night #2 (1608)	<b>Summary</b>	LAF1	44.5 dB	
Time	10/07/2012 03:05:17	LAeq	39.6 dB	LAF5	42.0 dB
Duration	00:30:00	LAE	72.2 dB	LAF10	41.0 dB
Instrument	GO56143, CR:171B	LAFMax	52.9 dB	LAF50	39.1 dB
				LAF90	37.4 dB
				LAF95	37.0 dB
				LAF99	36.5 dB

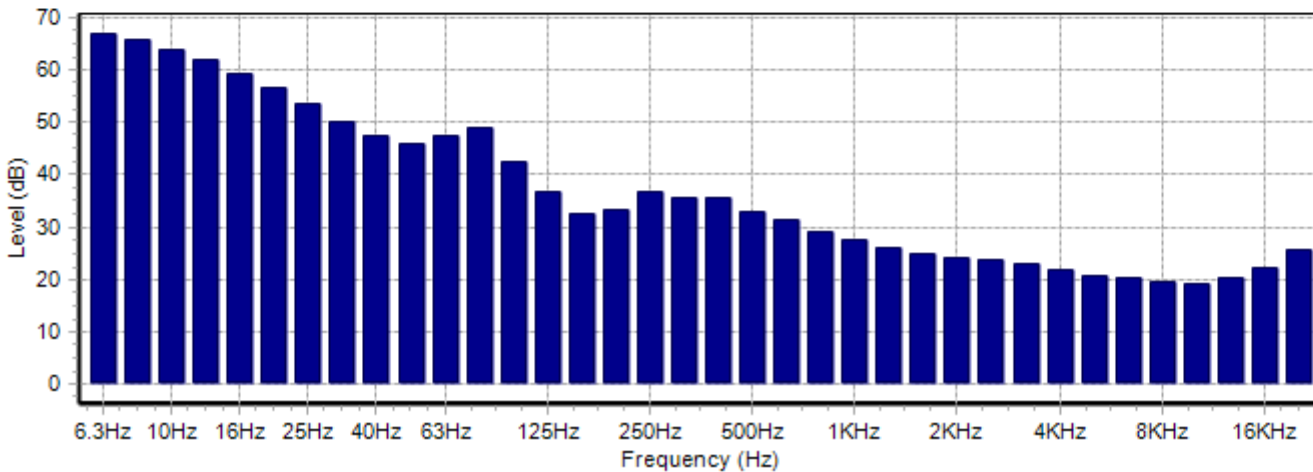
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 4\_ Day #1 (1585)  
 Time 09/07/2012 11:46:37  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

#### Summary

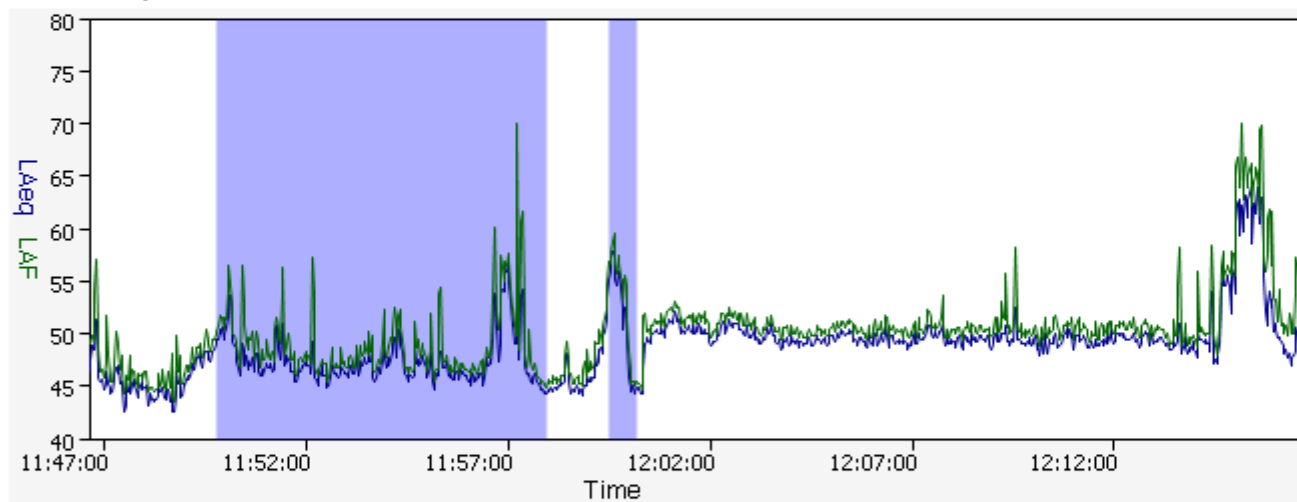
LAeq 50.8 dB  
 LAE 83.3 dB  
 LAFMax 70.1 dB

LAF1 61.5 dB  
 LAF5 54.3 dB  
 LAF10 51.0 dB  
 LAF50 48.8 dB  
 LAF90 45.1 dB  
 LAF95 44.5 dB  
 LAF99 43.4 dB

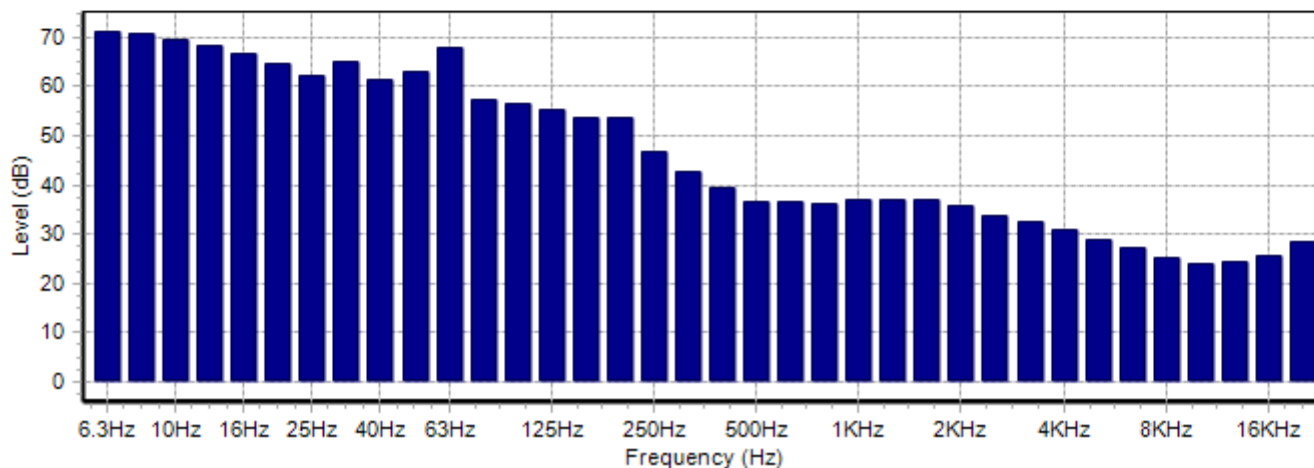
#### Calibration Information

10/07/2012 11:43:09 -0.15 dB

Time History



Frequency Bands





## Measurement Summary Report

Name NSL 4\_Day #2 (1586)  
 Time 09/07/2012 12:18:14  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

### Summary

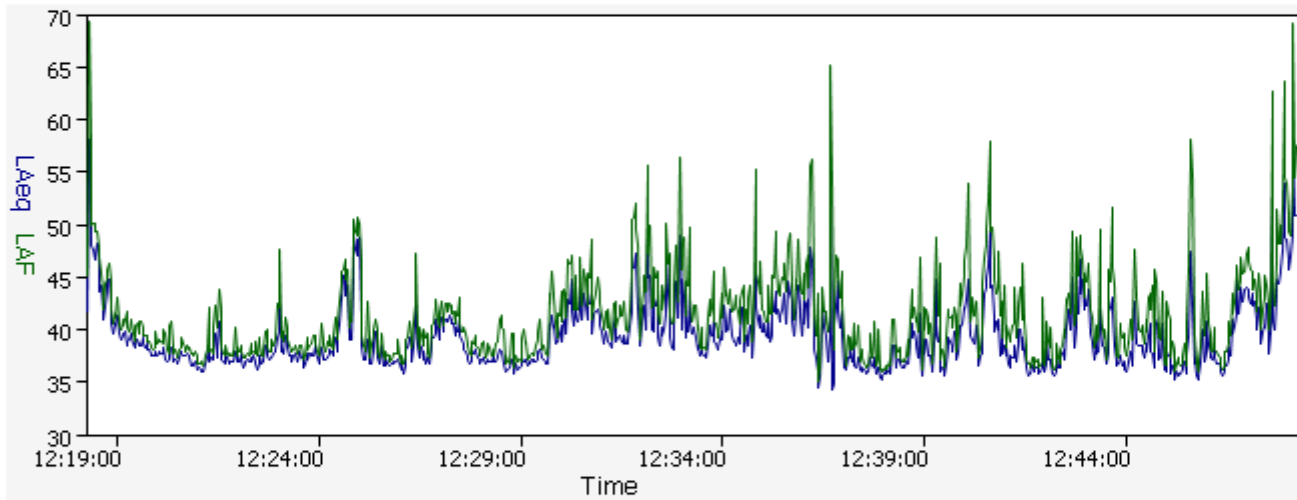
LAeq 41.3 dB  
 LAE 73.9 dB  
 LAFMax 69.4 dB

LAF1 49.3 dB  
 LAF5 45.3 dB  
 LAF10 43.2 dB  
 LAF50 38.1 dB  
 LAF90 36.2 dB  
 LAF95 35.8 dB  
 LAF99 35.2 dB

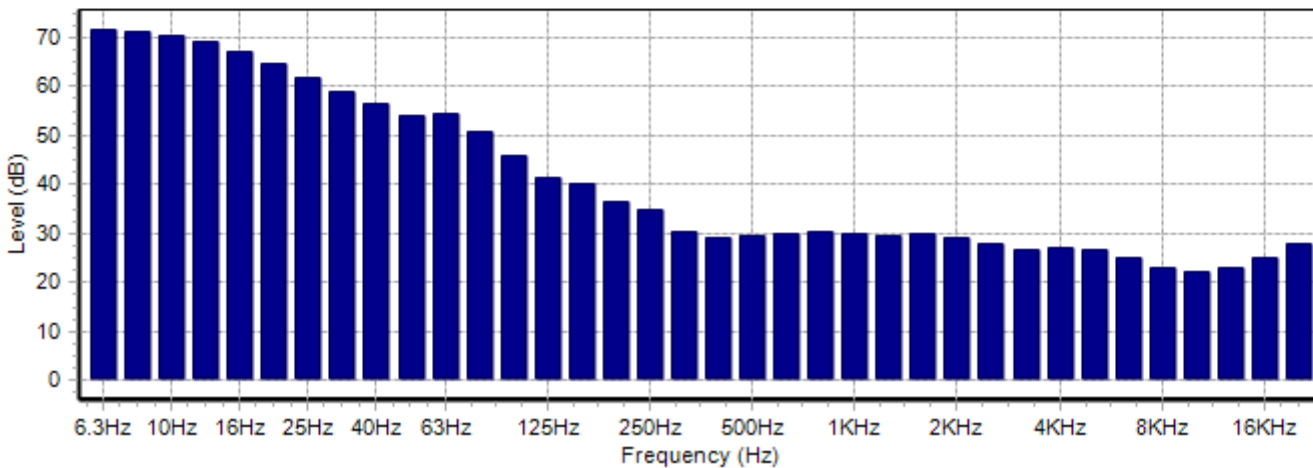
### Calibration Information

10/07/2012 11:43:09 -0.15 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 4\_Day #3 (1595)  
 Time 09/07/2012 18:23:39  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

**Summary**

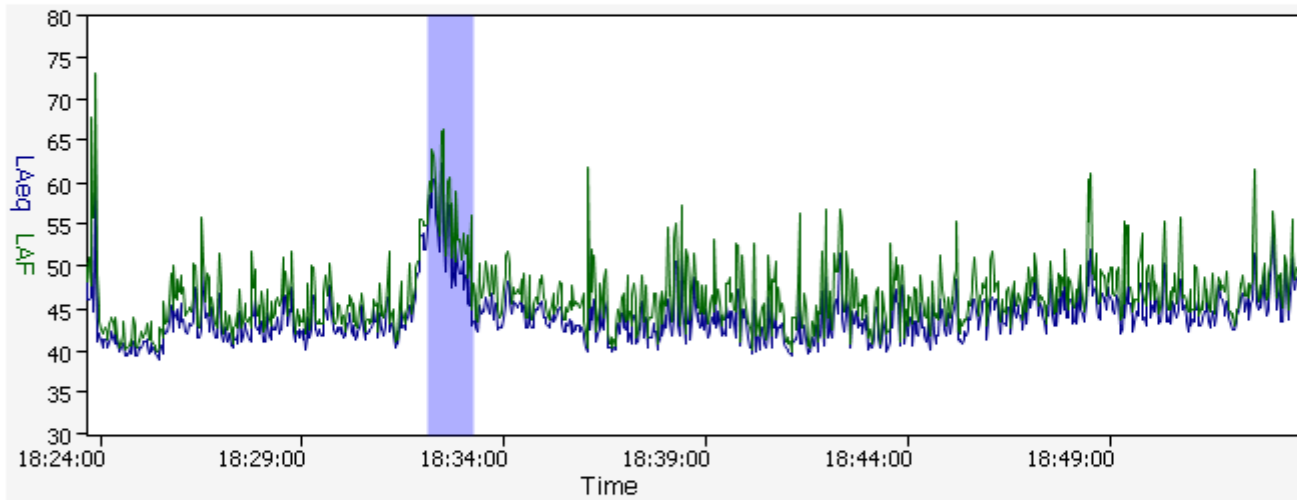
LAeq 46.5 dB  
 LAE 79.0 dB  
 LAFMax 73.0 dB

LAF1 56.6 dB  
 LAF5 49.8 dB  
 LAF10 47.5 dB  
 LAF50 43.2 dB  
 LAF90 40.4 dB  
 LAF95 40.0 dB  
 LAF99 39.3 dB

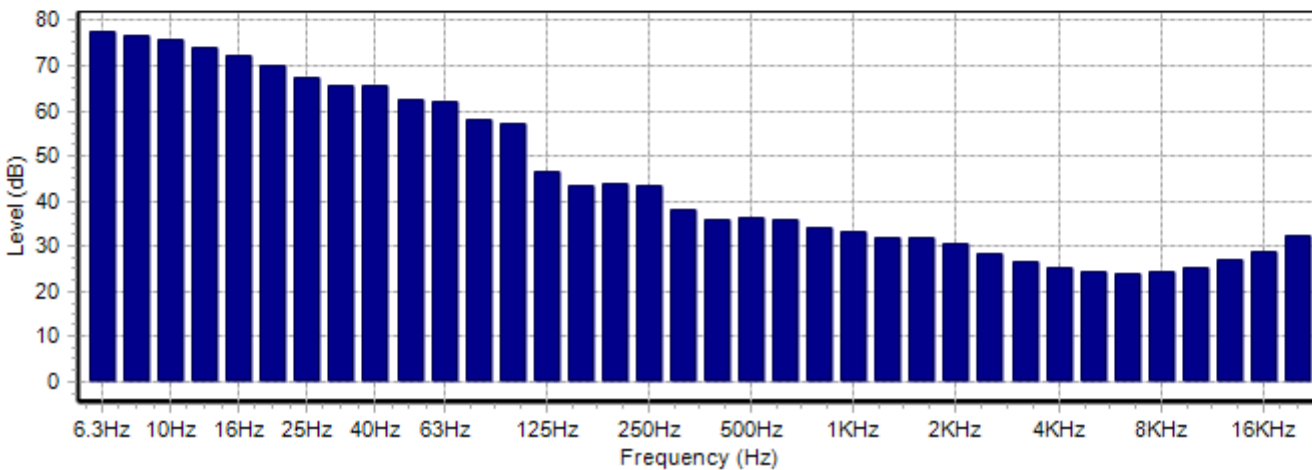
**Calibration Information**

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





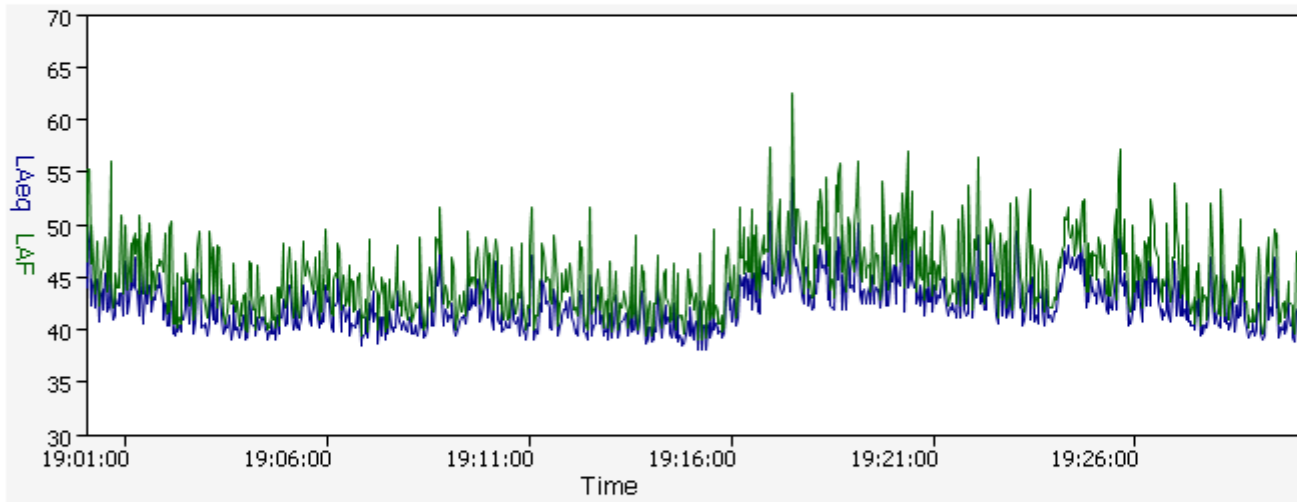
## Measurement Summary Report

Name	NSL 4_Evening (1596)	<b>Summary</b>	LAF1	50.4 dB
Time	09/07/2012 19:00:01	LAeq	LAF5	47.0 dB
Duration	00:30:00	LAE	LAF10	45.5 dB
Instrument	GO56143, CR:171B	LAFMax	LAF50	41.5 dB
			LAF90	39.3 dB
			LAF95	39.0 dB
			LAF99	38.3 dB

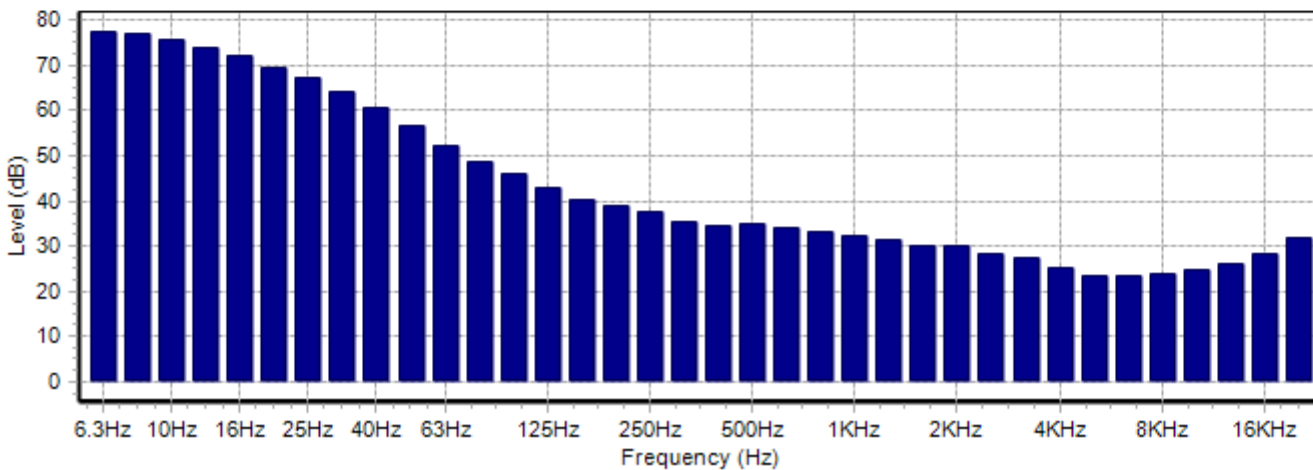
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





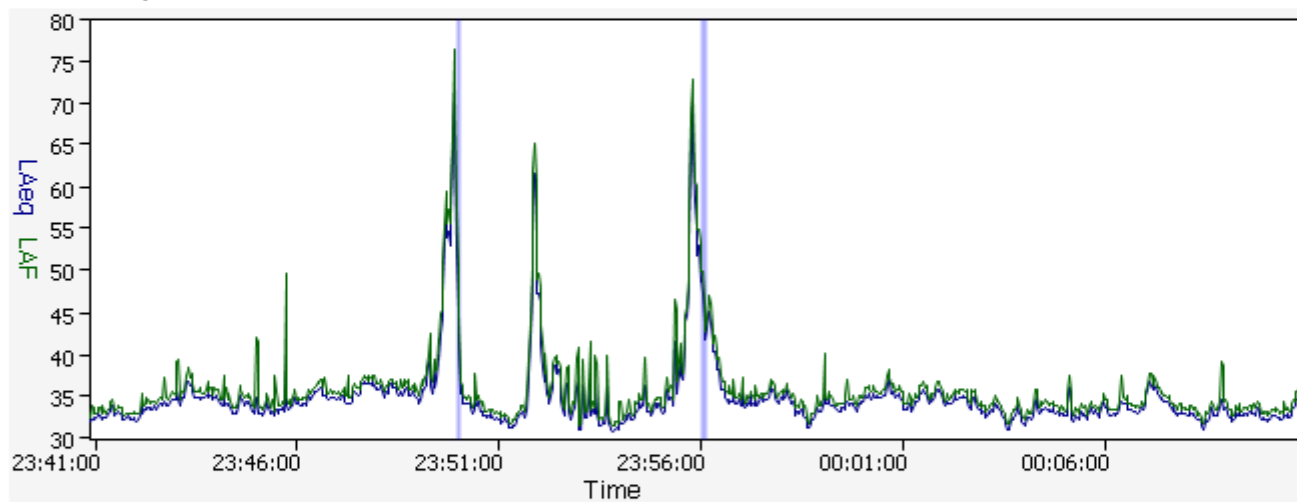
## Measurement Summary Report

Name	NSL 4_Night #1 (1602)	<b>Summary</b>	LAF1	57.3 dB	
Time	09/07/2012 23:40:51	LAeq	47.5 dB	LAF5	41.1 dB
Duration	00:30:00	LAE	80.0 dB	LAF10	36.6 dB
Instrument	GO56143, CR:171B	LAFMax	76.3 dB	LAF50	33.9 dB
				LAF90	32.2 dB
				LAF95	31.8 dB
				LAF99	31.0 dB

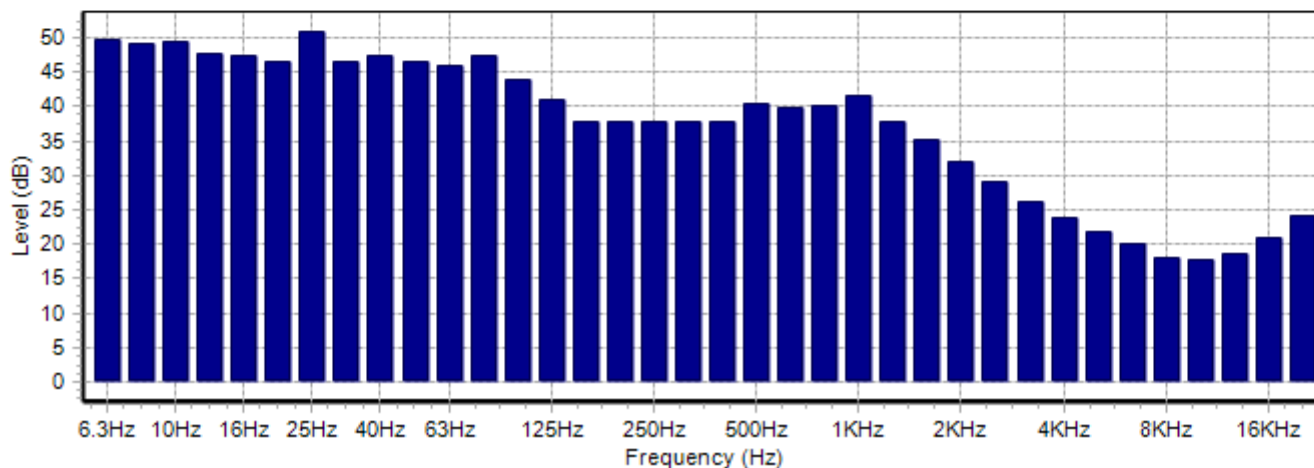
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 4\_Night #2 (1603)  
 Time 10/07/2012 00:11:37  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

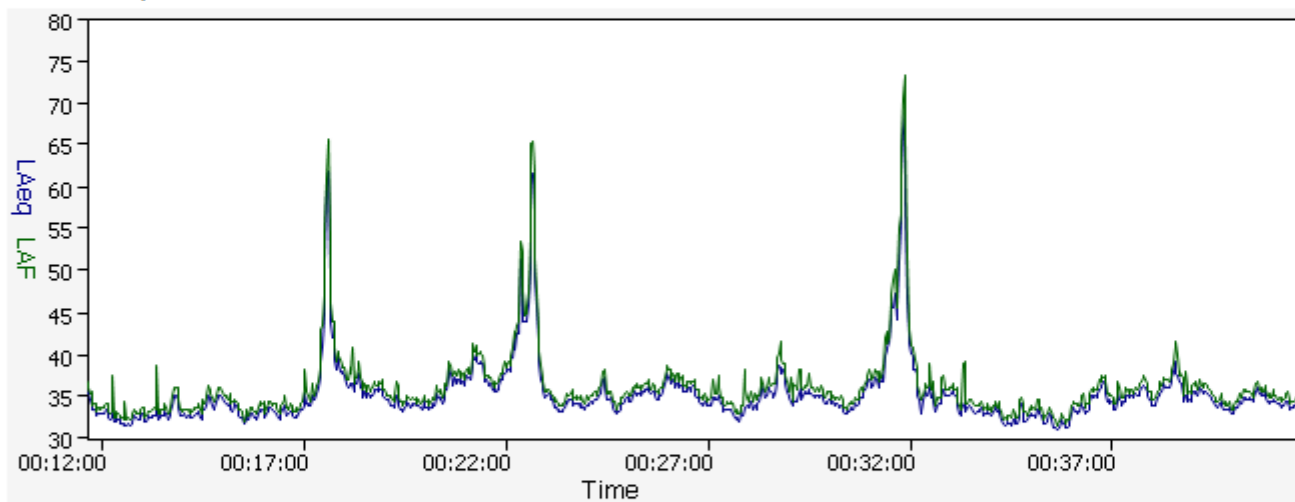
**Summary**  
 LAeq 44.5 dB  
 LAE 77.1 dB  
 LAFMax 73.2 dB

LAF1 55.0 dB  
 LAF5 40.5 dB  
 LAF10 37.5 dB  
 LAF50 34.4 dB  
 LAF90 32.5 dB  
 LAF95 32.0 dB  
 LAF99 31.4 dB

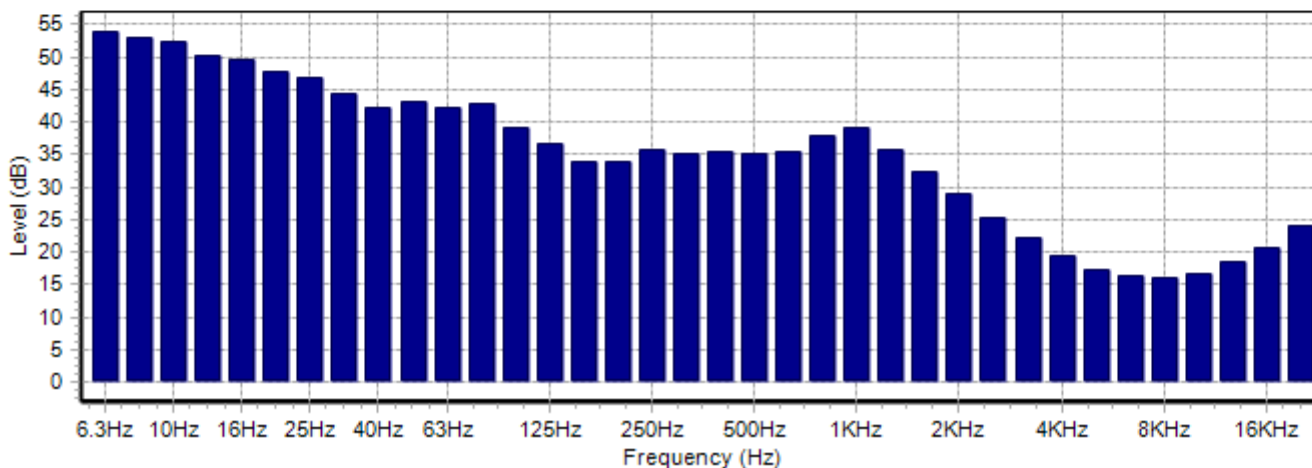
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 5\_Day #1 (1589)  
 Time 09/07/2012 14:29:50  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

**Summary**

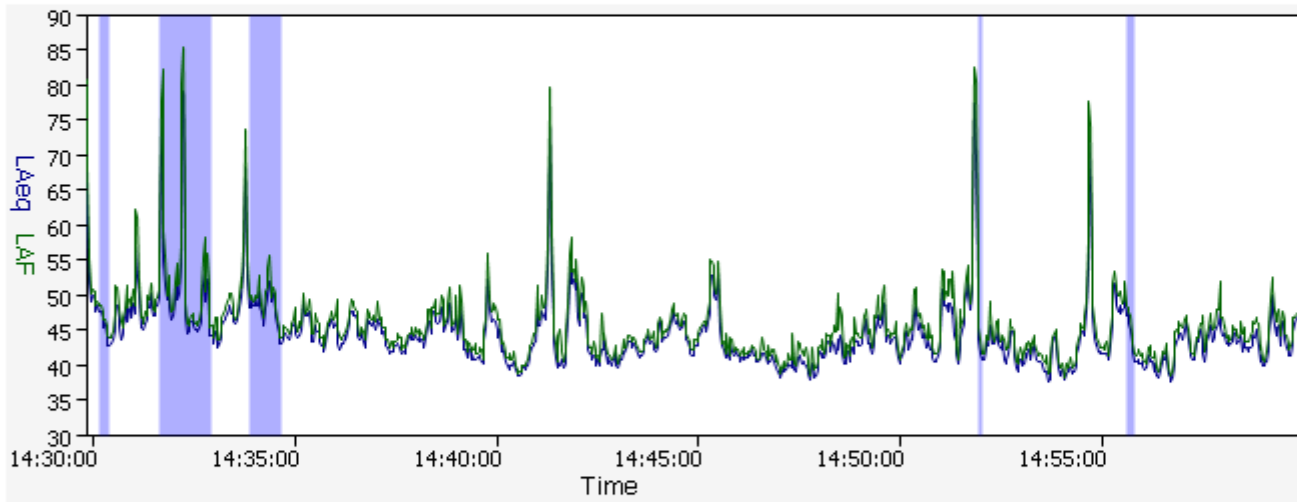
LAeq 56.2 dB  
 LAE 88.8 dB  
 LAFMax 85.3 dB

LAF1 63.1 dB  
 LAF5 50.8 dB  
 LAF10 48.8 dB  
 LAF50 43.5 dB  
 LAF90 39.9 dB  
 LAF95 39.1 dB  
 LAF99 38.0 dB

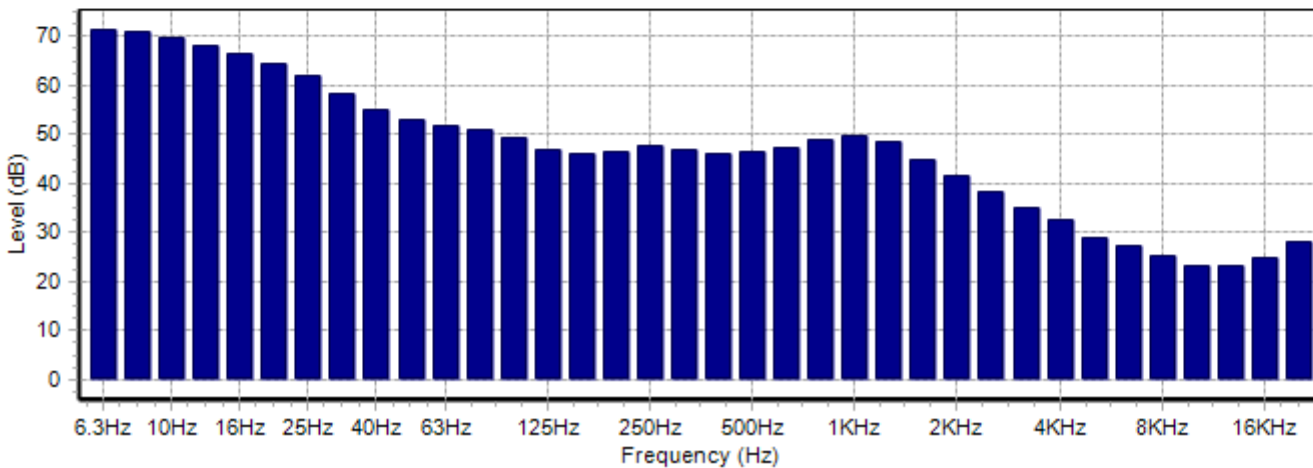
**Calibration Information**

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 5\_Day #2 (1591)  
 Time 09/07/2012 15:46:51  
 Duration 00:30:00  
 Instrument GO56143, CR:171B

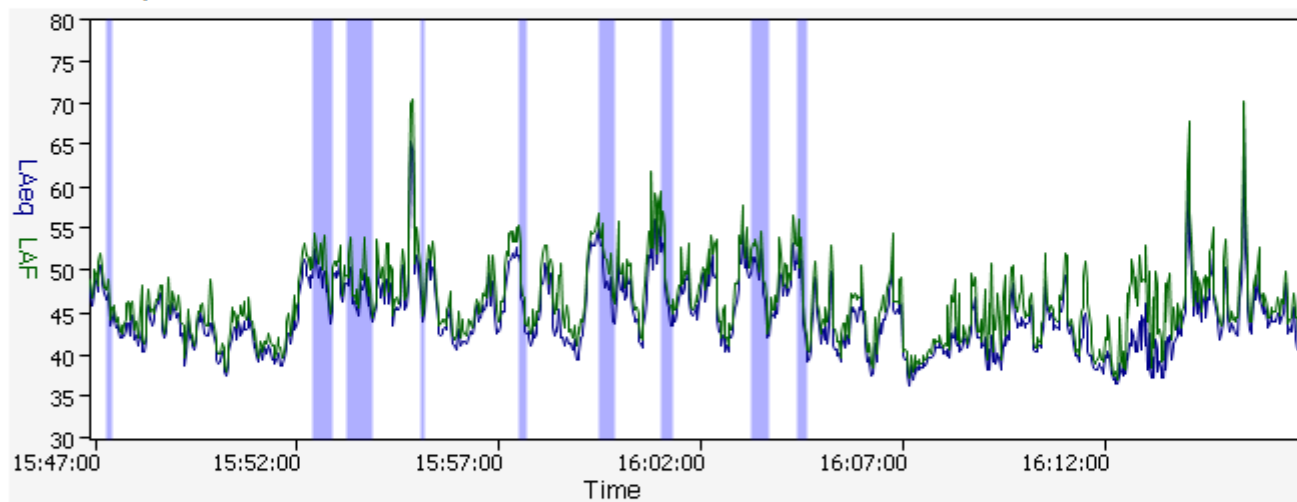
**Summary**  
 LAeq 47.8 dB  
 LAE 80.3 dB  
 LAFMax 70.2 dB

LAF1 55.0 dB  
 LAF5 51.8 dB  
 LAF10 50.0 dB  
 LAF50 43.9 dB  
 LAF90 39.1 dB  
 LAF95 38.1 dB  
 LAF99 36.8 dB

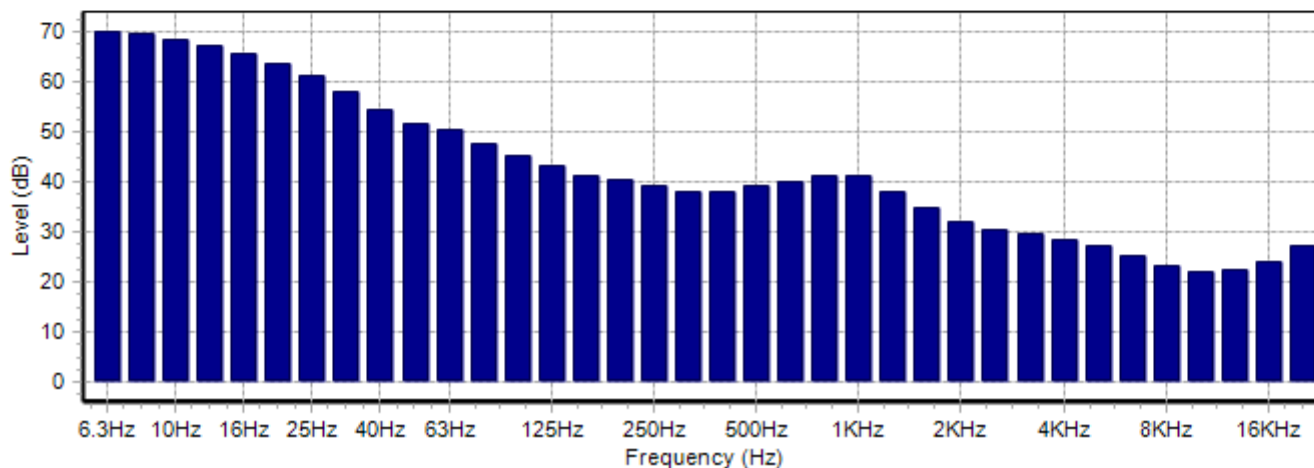
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 5\_Day #3 (1114)  
 Time 21/08/2012 16:39:33  
 Duration 00:25:03  
 Instrument GO56143, CR:171B

**Summary**

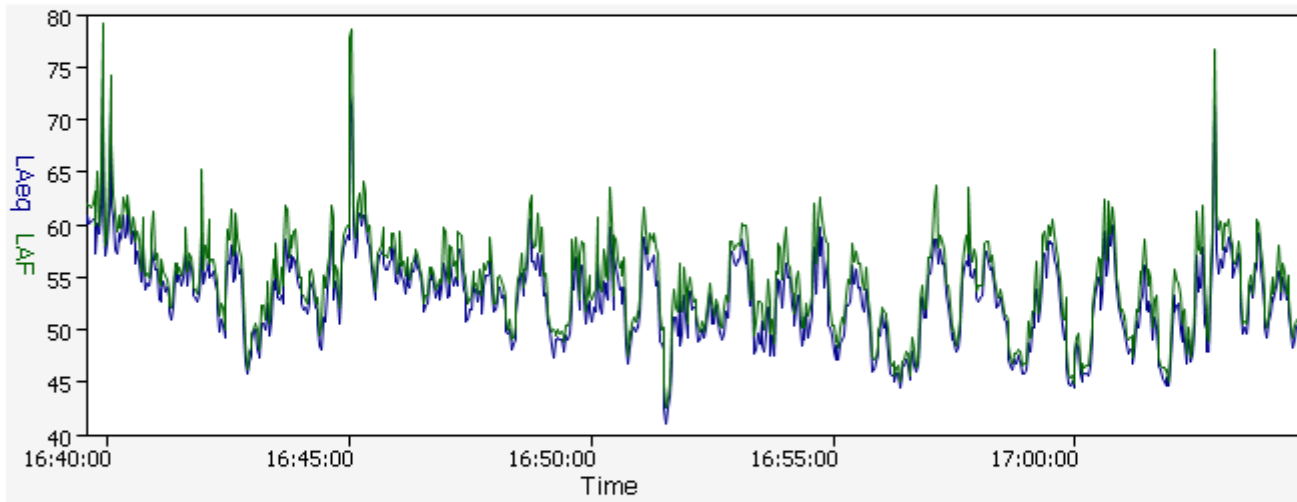
LAeq 56.2 dB  
 LAE 88.0 dB  
 LAFMax 79.2 dB

LAF1 62.4 dB  
 LAF5 59.3 dB  
 LAF10 58.0 dB  
 LAF50 53.0 dB  
 LAF90 47.3 dB  
 LAF95 46.1 dB  
 LAF99 44.5 dB

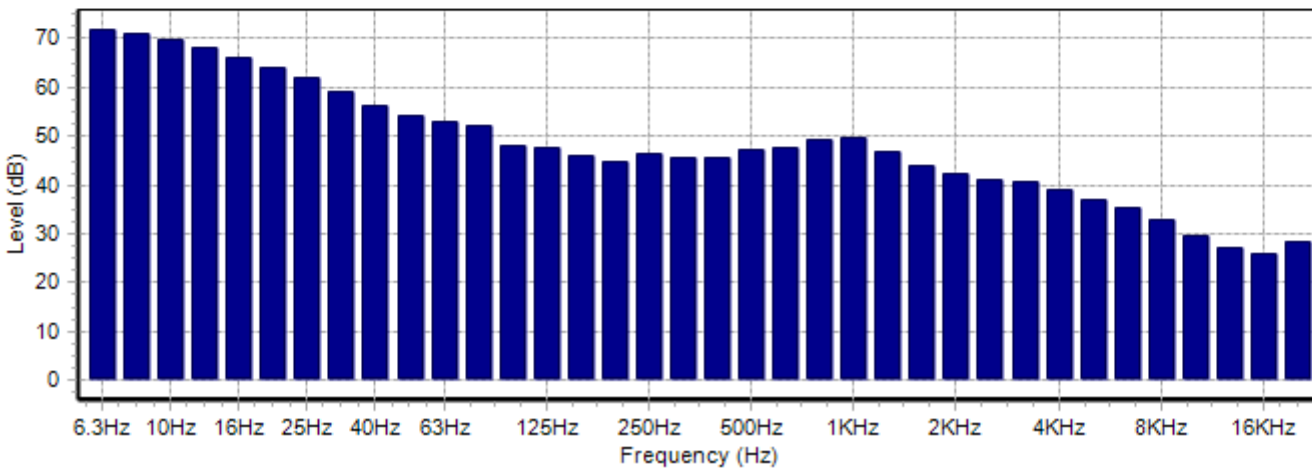
**Calibration Information**

21/08/2012 15:04:22 0.56 dB  
 22/08/2012 22:09:10 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 5\_Evening (1598)  
 Time 09/07/2012 20:17:21  
 Duration 00:28:16  
 Instrument GO56143, CR:171B

**Summary**

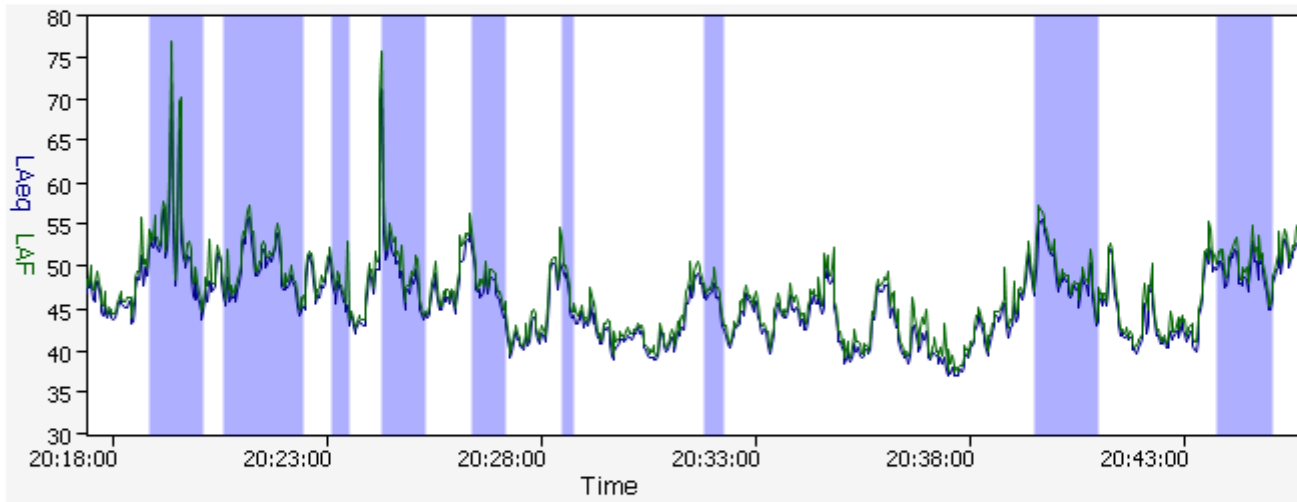
LAeq 50.3 dB  
 LAE 82.6 dB  
 LAFMax 76.8 dB

LAF1 56.1 dB  
 LAF5 52.7 dB  
 LAF10 51.3 dB  
 LAF50 45.6 dB  
 LAF90 40.1 dB  
 LAF95 39.3 dB  
 LAF99 37.4 dB

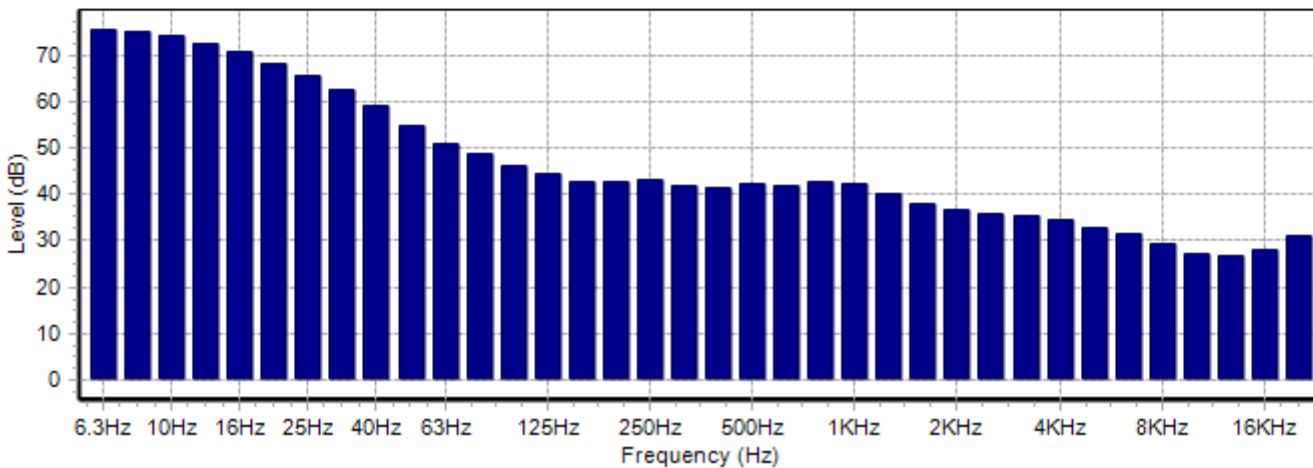
**Calibration Information**

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





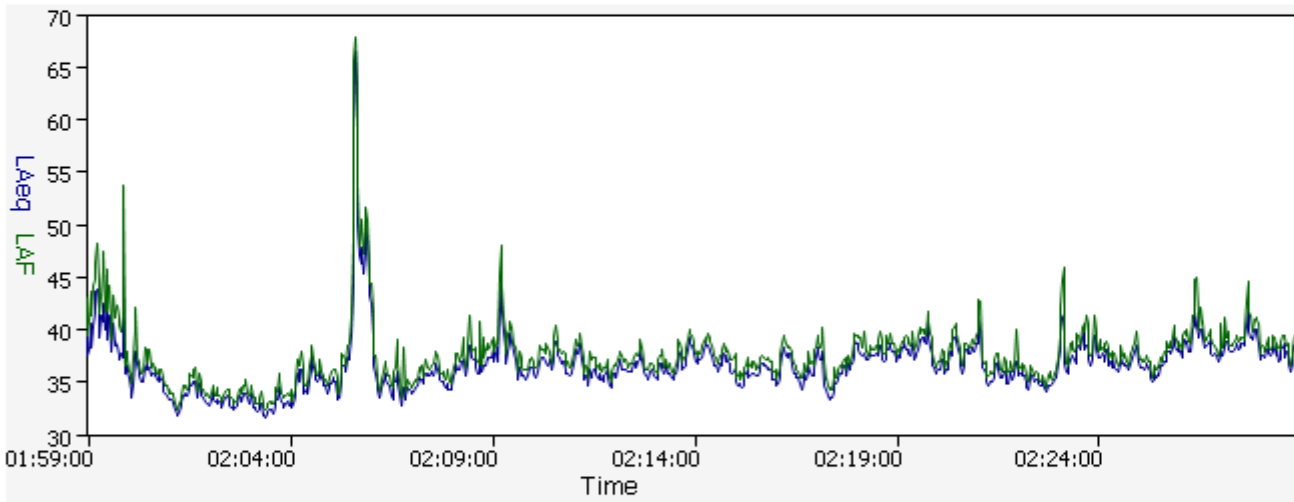
### Measurement Summary Report

Name	NSL 5_Night #1 (1606)	<b>Summary</b>	LAF1	46.7 dB	
Time	10/07/2012 01:58:55	LAeq	40.9 dB	LAF5	39.8 dB
Duration	00:30:00	LAE	73.4 dB	LAF10	38.8 dB
Instrument	GO56143, CR:171B	LAFMax	67.8 dB	LAF50	36.3 dB
				LAF90	33.7 dB
				LAF95	32.9 dB
				LAF99	32.1 dB

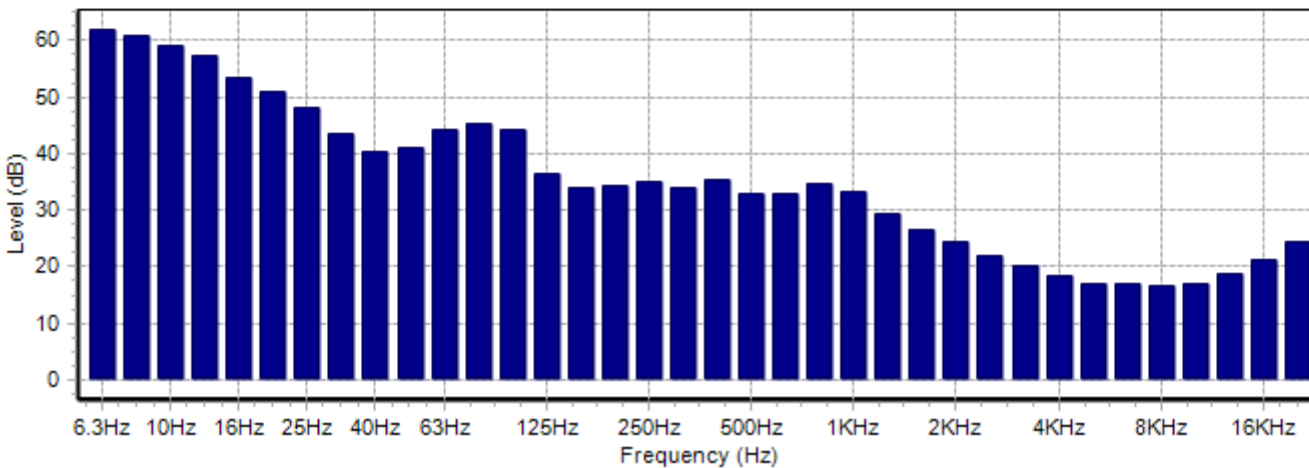
### Calibration Information

09/07/2012 12:57:54 0.34 dB  
 10/07/2012 03:38:49 0.39 dB

Time History



Frequency Bands





### Measurement Summary Report

Name NSL 5\_Night#2 (1125)  
 Time 23/08/2012 02:29:56  
 Duration 00:27:13  
 Instrument GO56143, CR:171B

#### Summary

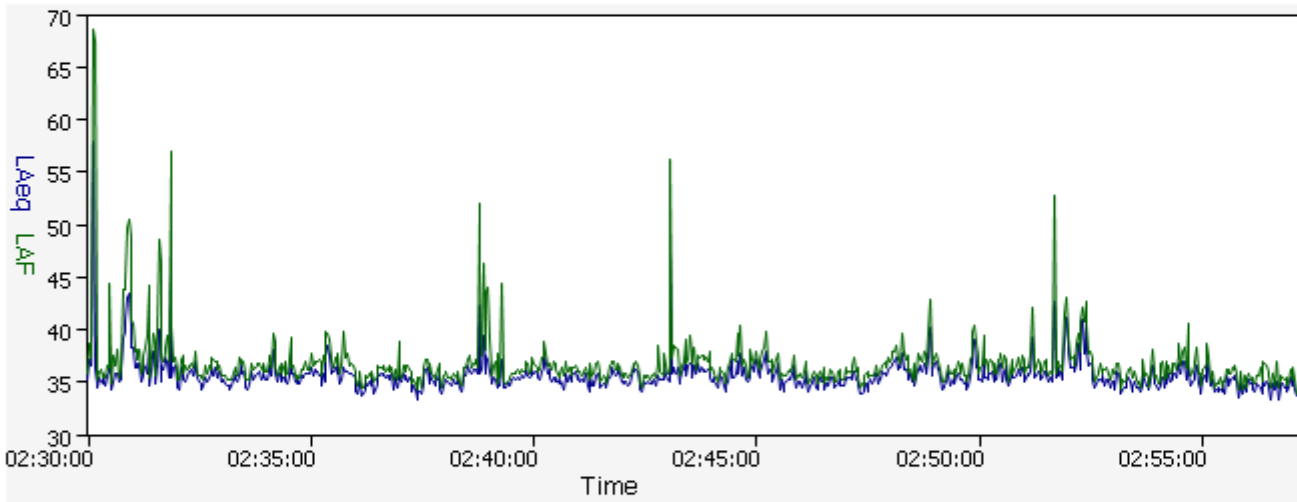
LAeq 36.7 dB  
 LAE 68.8 dB  
 LAFMax 68.6 dB

LAF1 40.5 dB  
 LAF5 37.4 dB  
 LAF10 36.7 dB  
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 LAF90 34.3 dB  
 LAF95 34.0 dB  
 LAF99 33.5 dB

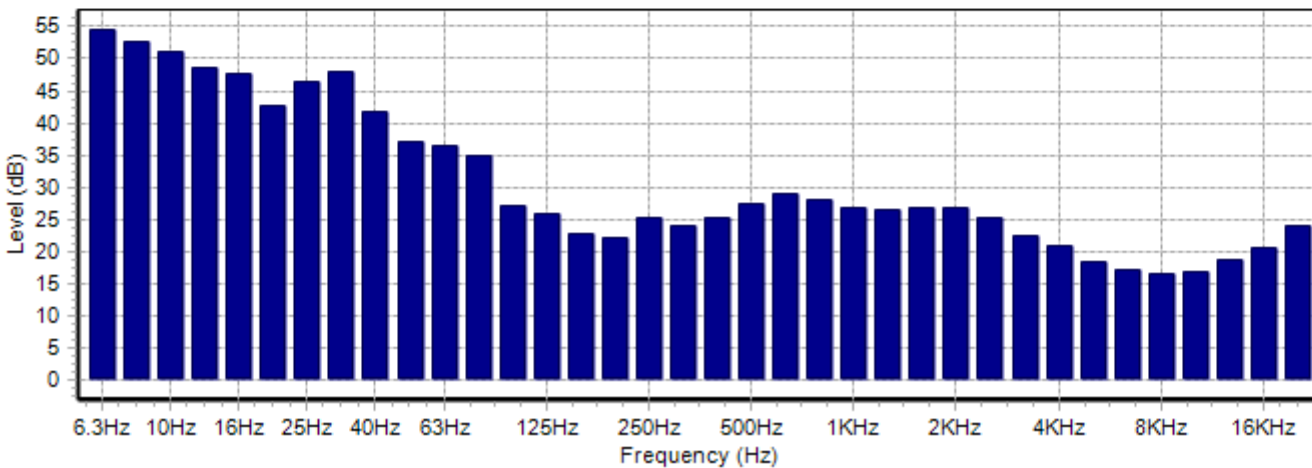
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Time History



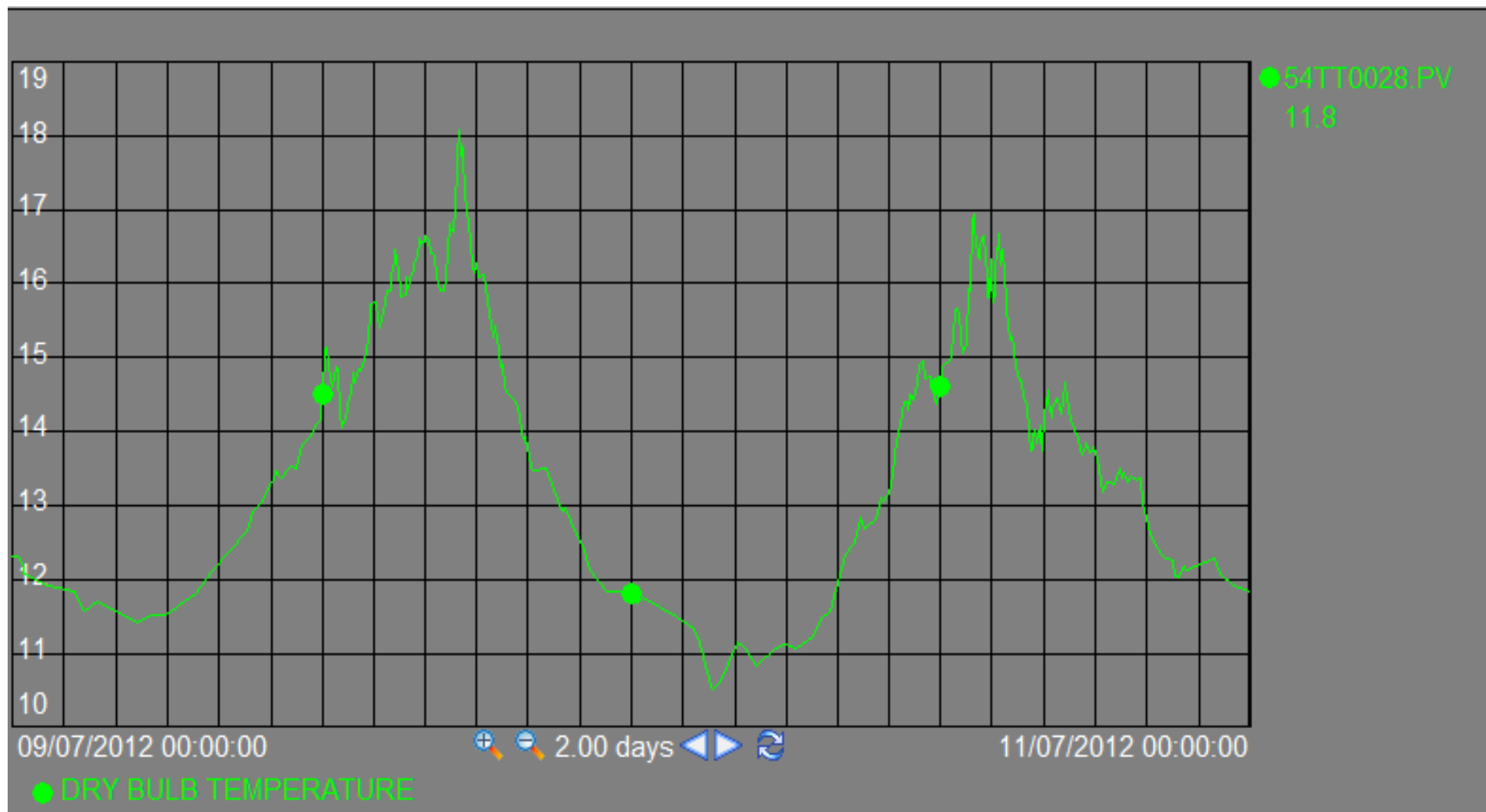
Frequency Bands



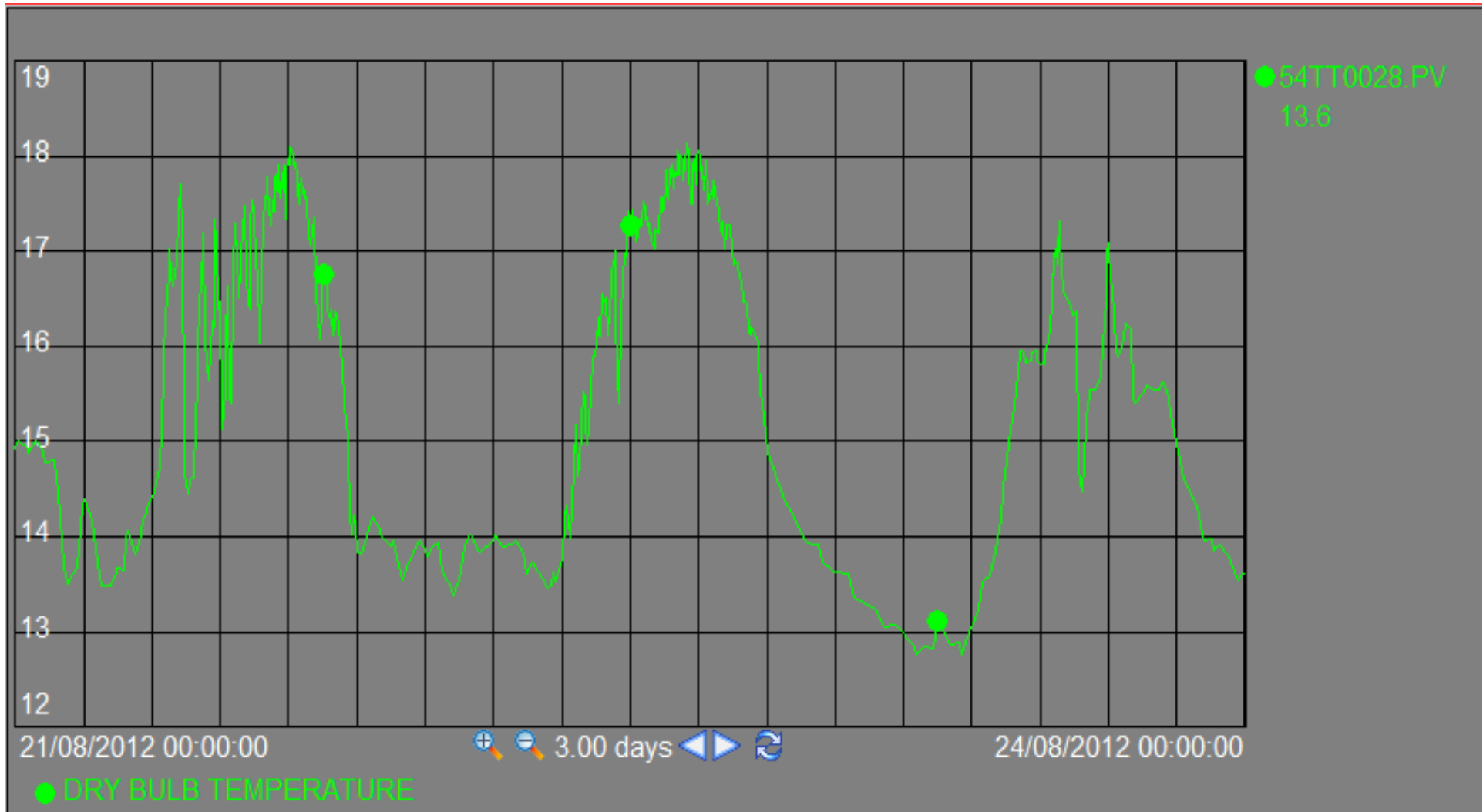
# Attachment E Weather Reports

# Aughinish Weather Data

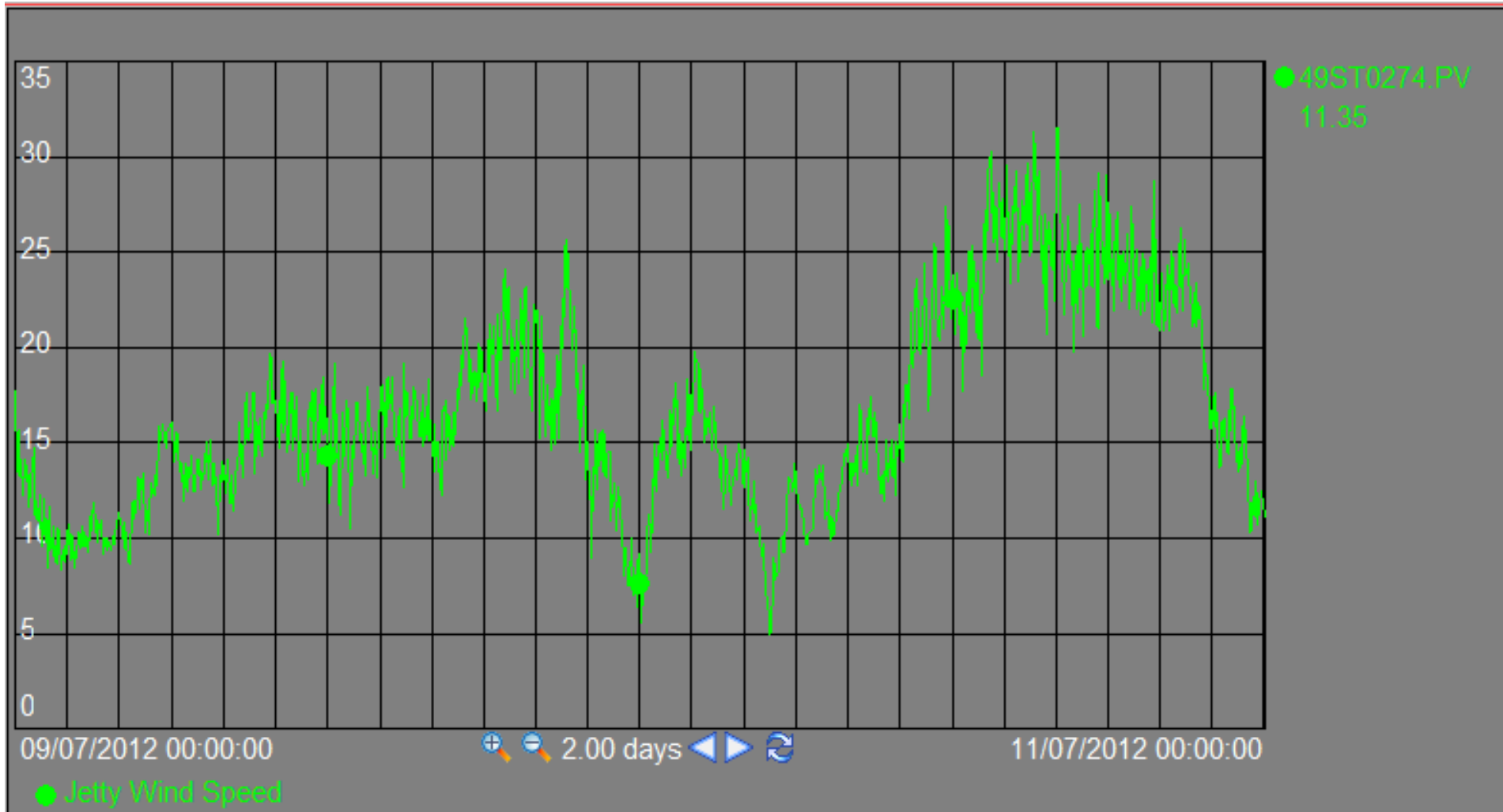
Temperature(°C) 09/07/2012 – 10/07/2012



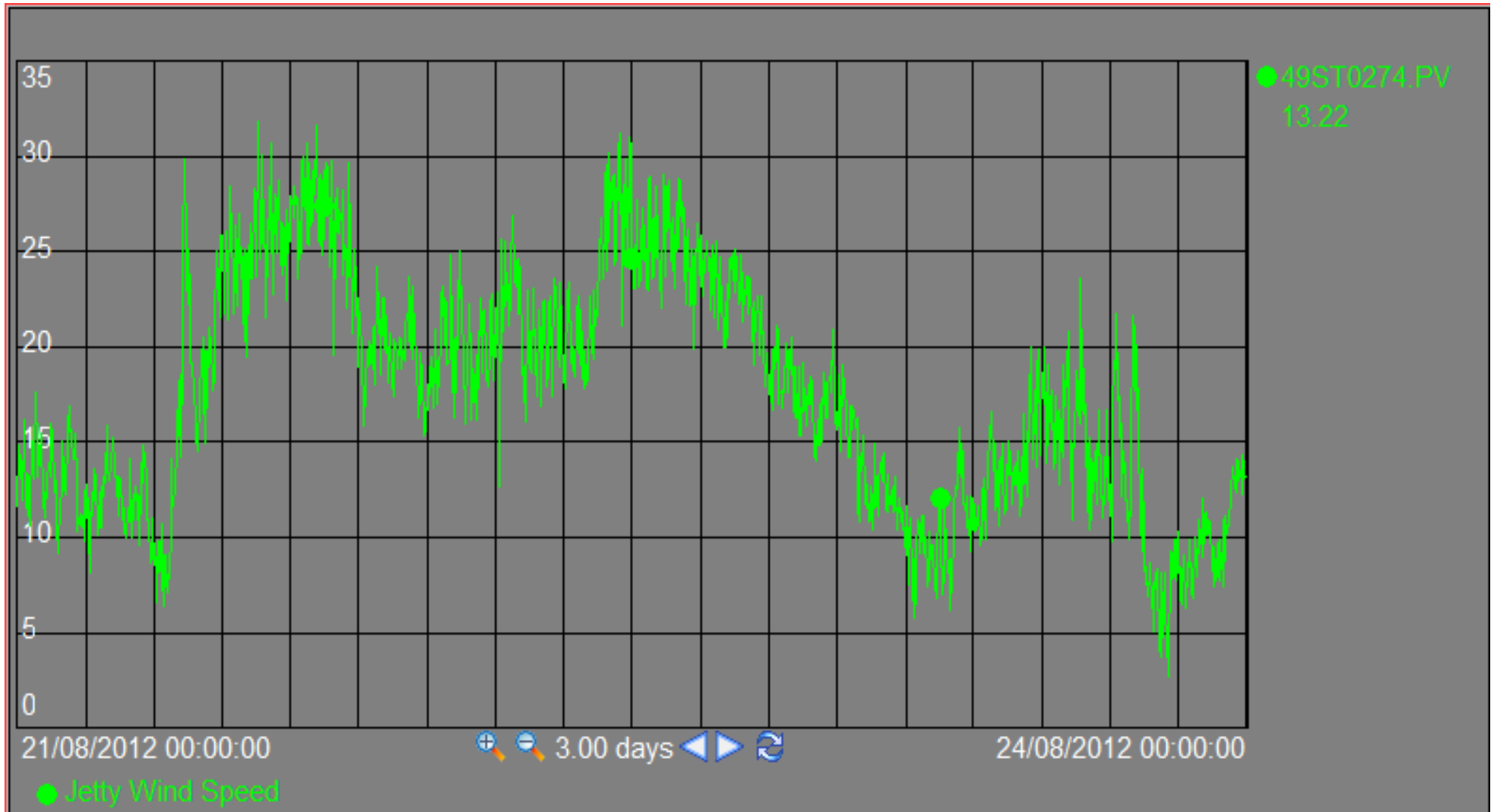
Temperature (°C) 21/08/2012 – 23/08/2012



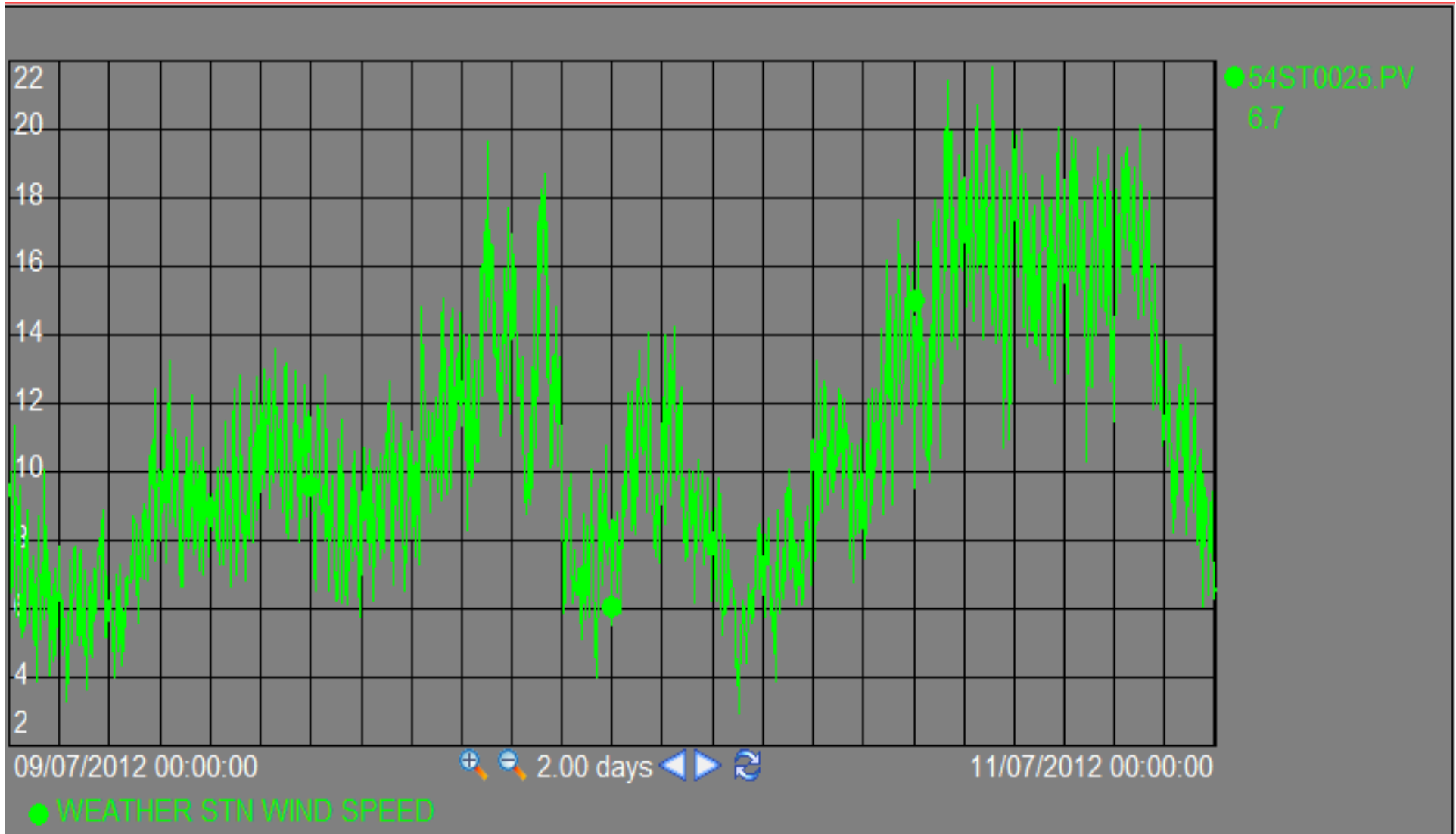
Wind Speed Jetty (mph) 09/07/2012 – 10/07/2012



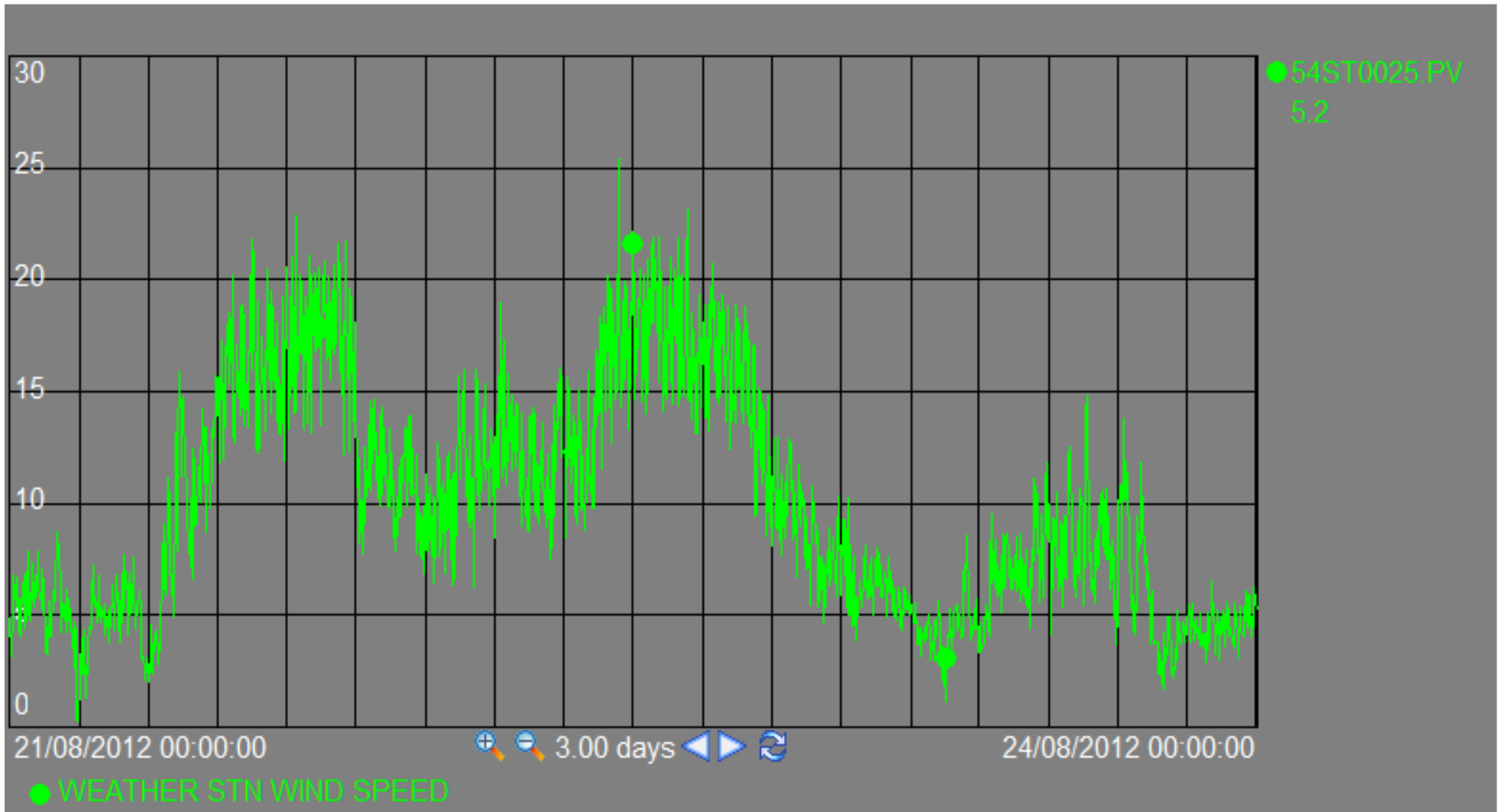
Wind Speed Jetty (mph)21/08/2012 – 23/08/2012



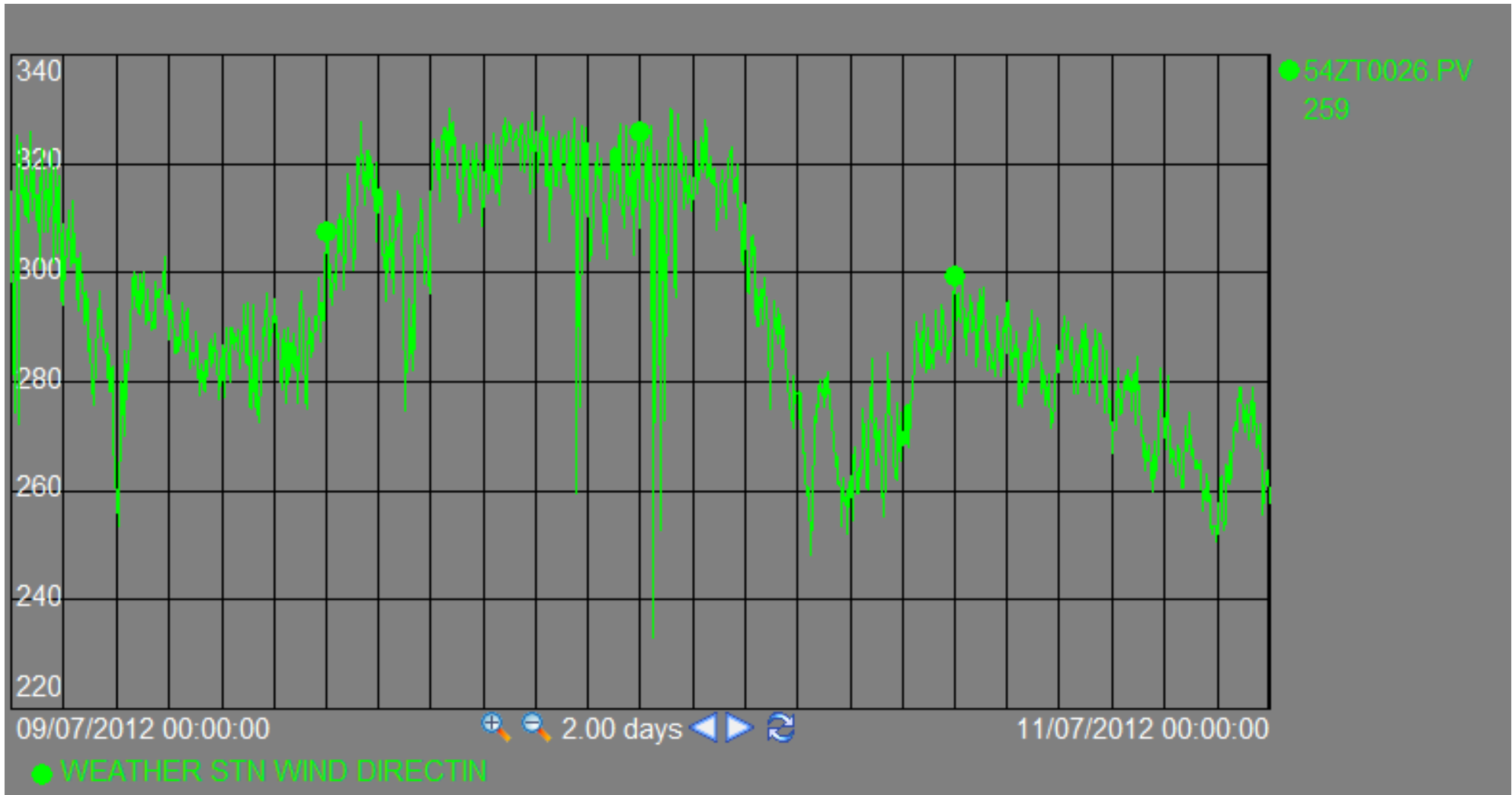
Wind Speed BRDA (mph) 09/07/2012 – 10/07/2012



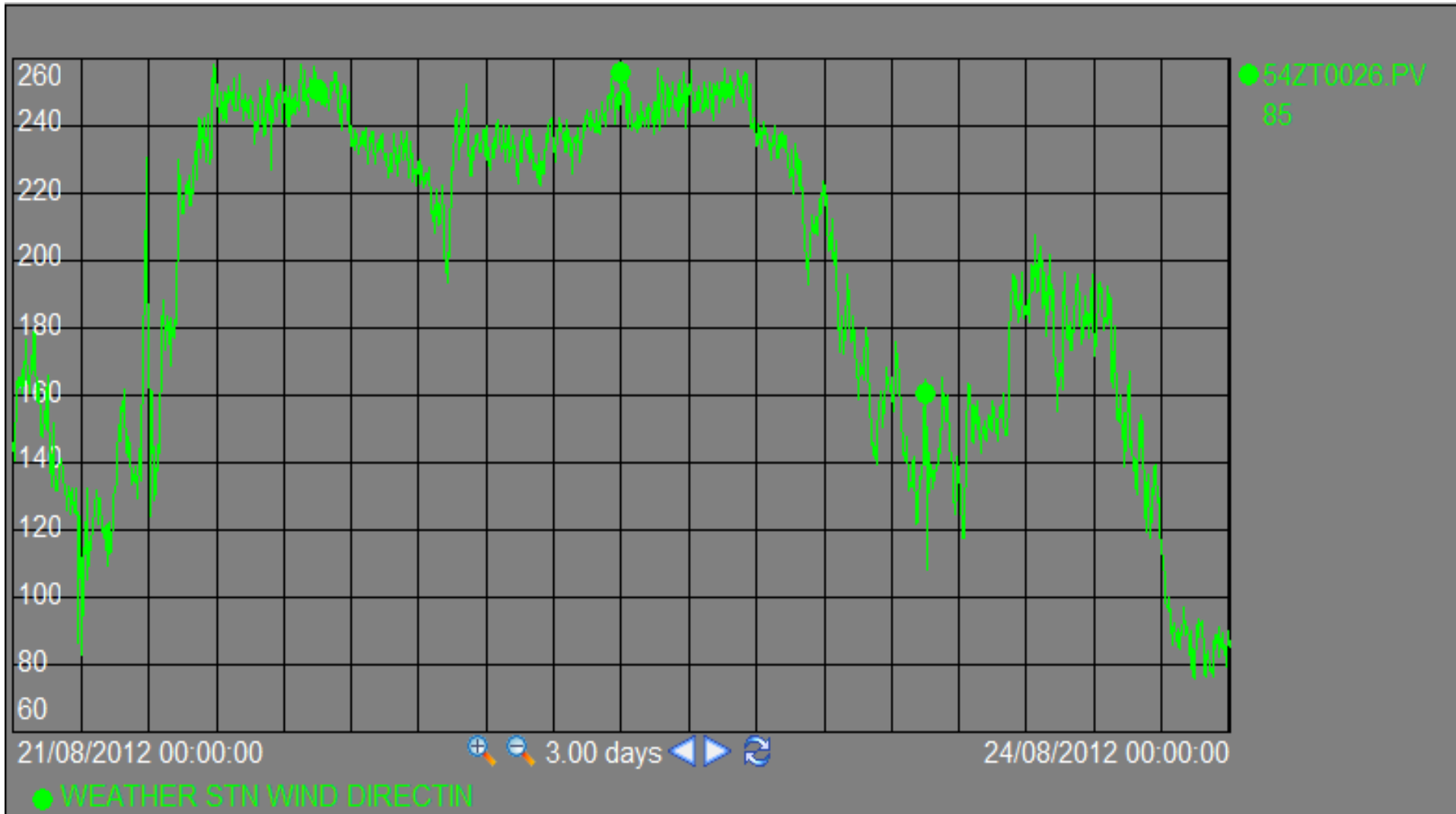
Wind Speed BRDA (mph) 21/08/2012 – 23/08/2012



Wind Direction (degrees) 09/07/2012 – 10/07/2012



Wind Direction (degrees) 21/08/2012 – 23/08/2012



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## **Attachment 6**

# **BRDA Operational Plan**

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# RUSAL Aughinish IPPC Licence P0035-04

## Bauxite Residue Disposal Area

### Operational Manual



**March 2013**

Prepared by: P O'Loughlin Date: 12.10.04	Approval L Fleming:	Date:	Reference No. BRDA Operational Plan BRDA OP001	Issue 1
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# Bauxite Residue Disposal Area (BRDA)

## Operational Manual

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## 1.0 Introduction

The Bauxite Residue Disposal Area (BRDA) is a dedicated facility, owned, developed and operated by RUSAL Aughinish Ltd as the landfill/tailings storage area for the permanent deposition of specific bauxite and process residues generated within the alumina extraction plant.

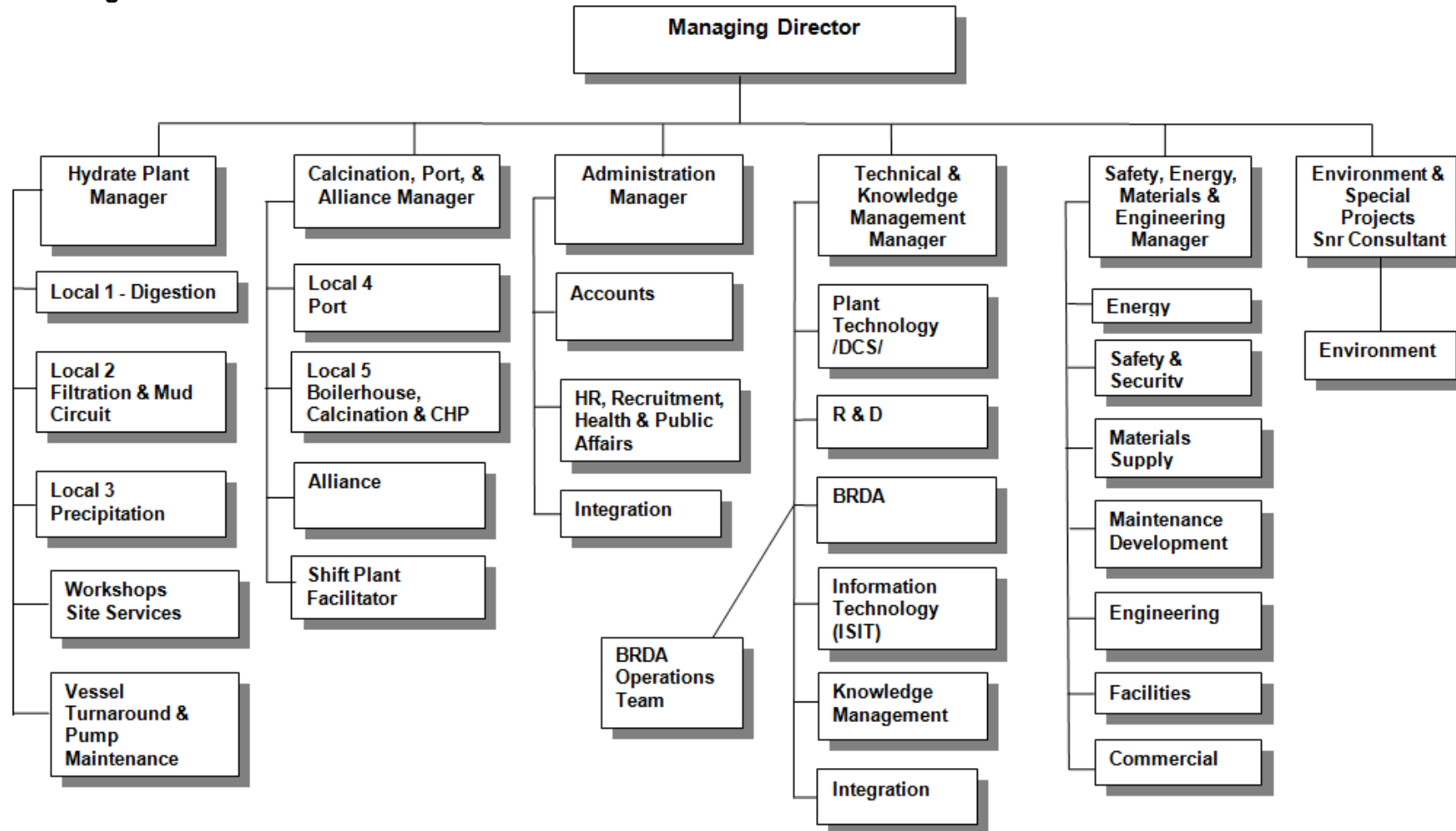
This Operational Plan includes all relevant data for the effective operation, monitoring long-term planning and aftercare of the BRDA. It is intended to demonstrate that the BRDA operations are in accordance with best management practices, the environmental policies of RUSAL Aughinish Ltd and the existing IPPCL conditions.

This Operational Plan has been structured in order to facilitate a clear presentation of relevant information as required by Condition 8.3.

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Figure 1 Organisation Chart



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## 2.0 Site Management and Responsibilities

The Technical and Knowledge Management Manager has overall responsibility for the operation of the Bauxite Residue Disposal Area (BRDA).

The BRDA is referred to as Area 54 (A54). The BRDA Operations Engineer has functional and administrative responsibility for the management of the BRDA.

Placement of waste material within the BRDA is undertaken by Murphy International Ltd. under a Site Process Materials Management Contract (SPM Management Contract).

The BRDA Specialist Contractor has responsibility for mud farming operations.

The BRDA Operations Facilitator has overall responsibility for day-to-day operations.

The BRDA Operations Team has overall responsibility for technical developments in the residue production and the day to day operations.

The BRDA Operations Team includes:

- BRDA Operations Engineer.
- Engineering Dept. Consultant Engineer
- BRDA Operations Facilitator
- SPM Management Contractor
- BRDA Specialist Contractor

The Engineering Dept. Consultant Engineer has functional responsibility for all technical developments within the BRDA area and advises the BRDA Operations Team.

The SPM Management Contractor is responsible for all landfill operations and maintenance as per contract.

All queries from members of the public are managed by the Human Resources (HR) Manager.

All liaison with and queries from the EPA are managed by the Environmental Coordinator.

The following describes the personnel associated with the BRDA and their roles and responsibilities.

### **Operation of the BRDA**

The day-to-day operation of the BRDA is carried out under the SPM Management Contract. Under this contract, Murphy International Ltd. (the Contractor) has responsibility for the following:

- Collection, transport and placement of all process plant residues at the BRDA.
- Maintenance and organisation of red mud placement operations.

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- Reporting of waste quantities deposited to the BRDA to the Environmental Dept.
- Organisation and development of all landfill operations and maintenance, including construction of internal access roads.
- Organisation and implementation of all internal storage developments within the BRDA, including perimeter rockfill construction.
- Organisation, implementation and maintenance of environmental protection measures.

The responsibilities of the BRDA Operations Team include:

1. Patrolling and liaising with the SPM Management Contractor on discharge points to be operated. Assessing the vulnerability of dusting and liaising with contractor on appropriate measures to suppress it.
2. Advising the Local 2 CRO to operate the dust suppression sprinkler system with water as and when required.
3. Submitting job tickets for any maintenance work required.
4. Formulation of medium and longer-term operating strategies.
5. The BRDA Operations Team with support from the Central Engineering Dept manages the construction of rockfill embankments on the periphery of the mud-stacking areas.

### ***Control of Mud Quality***

The Local 2 (L2) Control Room Operator (CRO) is responsible for monitoring mud throughput and mud line pressure.

The L2 Process Operator (PO) is responsible for sampling, field patrols, filter checks, pump checks, filter washing and mud line pressure control. The L2 PO has responsibility for bringing on- and off-line filters, washing filter cloths and flushing of vents when washing (1A, 1B, 2A, 2B, 3A, 3B and 50A/50B).

The L2 Process Engineer is responsible for monitoring and achieving all long-term trends and process targets in the Mud Filtration Area (Area 34).

### ***Continuity***

The BRDA is required to continuously store the bauxite residue generated in the process plant. This requires continuous management on a daily basis. The following sections outline the approach required to optimise the storage of the bauxite residue.

### ***Mud Washing***

The L2 CRO is responsible for, monitoring wash flow and filter speed.

The L2 PO is responsible for, sampling, field patrols, wash distribution and cloth repairs.

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**Management of Surface Water Runoff – Water Management**

The L2 CRO is responsible for monitoring pond levels and stream distribution. The CRO records any non-compliance in the L2 Day Log and reports these to the Shift Plant Facilitator (SPF). The SPF reports any non-compliances in the shiftlog.

The L2 PO is responsible for sampling, field valve set up and field patrols.

The Environment Coordinator is responsible for formal notification of the Environmental Protection Agency (EPA) as soon as practicable regarding IPPC licence non-compliances.

**Pond Cleanouts and Inspection**

The L2 Process Engineer and Facilitator are responsible for deciding when a clean-out may commence. Pond sludge is pumped to the effluent clarifier for recycling to the plant. The BRDA Operations Team decides where the remaining ‘non-pumpable’ sludge is disposed in the BRDA.

The Environmental Engineer is responsible for reviewing clean-out operations and to advise on environmental control measures as necessary.

The L2 CRO is responsible for monitoring any condensate dumps to the West Pond or its trenches.

The L2 PO is responsible for monitoring pumping from the Liquid Waste Pond during a normal clean-out.

The L2 Environmental Facilitator is responsible for inspection of ponds.

The Civil Engineering Department is responsible for monitoring and overseeing any repairs to the pond liners or concrete.

**Dust Emissions Control**

The L2 Equipment Facilitator is responsible for ensuring that no dusting occurs on the BRDA and to take the necessary measures to prevent dusting. These measures include ensuring the sprinkling system is applied appropriately to damp down potential fugitive dust emissions at all times.

The SPM Management Contractor is responsible for the maintenance, filling and operation of all mobile water sprayers and permanently installed sprinkler systems.

The SPM Management Contractor, BRDA Specialist Contractor and BRDA Field Facilitator maintains a watching brief for the meteorological conditions which favour dusting and are responsible for communicating this to the L2 Equipment Facilitator on a daily basis.

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### **Emergency Response**

In the event of a dusting emergency, the SPM Management Contractor is responsible for directly notifying the SPF and L2 CRO. Depending on the response required, the SPM Management Contractor has responsibility for requesting assistance, organising all dust suppression resources and ensuring that the Emergency Response Procedure (SWM 2022) is implemented.

Dusting is categorised a plant emergency. The plant emergency number (Ext. 4444) is used to contact Security in A79.

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### 3.0 Waste Analysis

#### 3.1 Waste Origin and Composition

All bauxite-derived solid and sludge residues arising from alumina production at the plant are directed to the BRDA in accordance with IPPC Licence conditions. Almost all the solid residue material arises from the initial caustic digestion of the bauxite ore. After exiting the bauxite digesters, the residue is segregated into two fractions, the fine red mud fraction, representing approximately 90% of the total and the coarse fraction, known as process sand, representing the other 10%.

Together these represent about 97% of the total bauxite residue from the plant. The remaining proportion comprises salt cake, from a salting-out liquor purification process and other process wastes including sand, scale, sludges and construction and demolition waste. Table 1 below lists the waste types approved by the EPA for placement within the BRDA.

**Table 1 Approved Waste Types**

- Red Mud
- Process Sand
- Salt Cake
- Process Scale
- Lime Grits
- Pond Cleanout Sludge (from LWP, SWP, North Pond, South Pond, East Pond, West Pond)
- Miscellaneous Refractory Material (non-hazardous)
- Building Rubble (used for roadway/embankment construction within the BRDA)
- Sludge from the Sanitary Treatment Plant A82 (emergency only)
- A34 Effluent Clarifier Underflow Sludge (discontinued)

The red mud is subject to counter-current washing to reduce the concentration of entrained caustic before being de-watered in a vacuum drum filter and pumped as slurry to the BRDA.

The coarser process sand fraction is delivered to the storage area in dumper trucks. Salt cake, lime grits, refractory and scale that are trucked to the BRDA, are confined to specific areas within the existing BRDA.

Accumulated sludges from process ponds are also deposited within the BRDA.

Table 2 overleaf shows the approximate composition of the main process residues disposed of to the BRDA.

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**Table 2 Process Residues deposited in the BRDA**

Waste Stream	European Waste Catalogue Code	Hazardous/ Non-Hazardous (EWC Classification)	Approximate % of Total Residue Deposited
Bauxite Residue (Red mud & sand)	01 03 09	Non-Hazardous	88%
Process Waste	01 03 99	Non-Hazardous	10%
Lime Grits	01 03 99	Non-Hazardous	1%
Salt Cake	01 03 07	Hazardous	2%

### 3.2 Waste Quantities

Data on waste composition and quantities is collected in accordance with IPPC Licence conditions and is included in quarterly reports and Annual Environmental Reports (AER's) to the EPA. 2010 data is included in Section 3 of the 2010 AER.

### 3.3 Physical Properties

The red mud residue is pumped from the mud separation area (Local 2) to the storage area as slurry with solids content of between 55% and 60%.

Once the mud has been discharged it begins to dry, with water being lost through "bleeding", surface evaporation and mud farming. It has been found that after an average 'maturing period' of 3 to 4 months for a mud layer of 0.3 to 0.6m thick, a solids content of around 68% to 70% is achieved.

Particle size analyses of red mud indicate that the material is largely silt size, with 90% of the particles smaller than 35 microns and 35% finer than 2 microns. The permeability of the mud is correspondingly very low and has been assessed to be in the range  $1 \times 10^{-8}$  to  $1 \times 10^{-9}$  m/sec. The average specific gravity of the dry mud solids is 3.3.

The process sand is poorly graded medium sand having 90% and 10% of the particles smaller than 500 and 100  $\mu$ m respectively. The permeability of the process sand is estimated to be about 1000 times greater than the permeability of the red mud.

Salt cake is deposited as a 70% solids cake.

### 3.4 Chemical Properties

The principal constituents of the red mud solids (expressed as the oxides) are iron oxide ( $Fe_2O_3$ ), aluminium oxide ( $Al_2O_3$ ) and titanium dioxide ( $TiO_2$ ).

The aqueous solution entrained within the red mud contains a small amount of residual dissolved caustic (sodium hydroxide) and alumina in spite of the repeated washing in the plant. It is this residual dissolved caustic that gives the red mud its elevated pH characteristics. Most of this caustic converts to sodium carbonate and sodium

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bicarbonate following deposition in the BRDA. This conversion process is accelerated and enhanced via atmospheric carbonation using the mud farming process.

Salt cake consists of the organic degradation products from humates in the bauxite, including sodium carbonate, sodium sulphate and sodium oxalate.

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## 4.0 Operational Principles

The following summarises the key operating principles for the BRDA:

1. The BRDA accepts only those residues described in and permitted by the current IPPC Licence.
2. The red mud is pumped to the BRDA at optimum solids and deposited in layers to maximise maturing by drying, consolidation and mud farming to optimise overall storage capacity of the BRDA.
3. The approach to the placement of red mud is based on mud farming as described in Section 5.
4. Storage capacity is developed within the BRDA by construction of rockfill embankments around the BRDA using upstream embankment construction where the underlying red mud supports the upper rockfill embankment.
5. The overall stability of the upstream rockfill core mud retention terraces around the perimeter of the BRDA is determined by routine monitoring and assessment of the undrained shear strength of the red mud and underlying estuarine soil.
6. The soda content of the red mud and other residues being deposited is minimised to optimise soda recovery in the plant and to minimise environmental liabilities associated with the BRDA. The soda content of the red mud is further reduced using the mud farming/atmospheric carbonation process.
7. The integrity of all HDPE geomembranes for environmental protection is maintained. No mobile equipment is permitted to come into direct contact with the geomembrane.
8. The runoff and leachate is directed to and collected in a perimeter channel and pumped back to the plant for treatment as described in Section 8.0.
9. The surface water inventories in the perimeter channel and adjacent Storm Water Pond (SWP) are minimised and pumping capacities are maximised as practicably as possible to ensure that there is sufficient operational freeboard for major rainfall events.
10. A water sprinkling dust suppression system is used over the entire red mud and process sand surfaces to prevent dusting.
11. The downstream toe drains, external watercourses and groundwater observation wells are routinely inspected and sampled in accordance with IPPCL conditions.
12. All incidents, whether of an environmental or health and safety nature are reported and investigated to ensure that any necessary remedial action is taken and to prevent any re-occurrence of the incident.

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## 5.0 Waste Handling and Placement

The BRDA is a dedicated and engineered facility for the placement of specific process residues as detailed below.

### 5.1 Red Mud

The majority of red mud slurry is pumped from the Mud Filtration Building in A34 to the BRDA at generally greater than 58% solids. A small proportion of low solids red mud slurry, collected from the maintenance turnaround cleaning of the mud settling and washing tanks, is trucked to the BRDA by the Contractor and deposited on existing red mud surfaces.

The red mud including low solids red mud is matured through surface evaporation and the mud farming process as described in 5.8.

The placement of red mud within the BRDA is controlled by the procedures: SWM 2022: Area 54A Operation of the BRDA; and SWM 2009 Minimise Mud Soda Losses and Maximise Mud Density to the BRDA.

The plant Waste Management Manual (WM001) also covers the placement of red mud (Section 4.3.2.9)

### 5.2 Process Sand

Process sand is the quartzite fraction of the bauxite residue. This is washed as effectively as possible to remove all leachable soda and in particular to extract all leachable sodium aluminate which could potentially contain product (refer to SWM 2006 Area 27A Operation).

Process sand is trucked by the Contractor from Area 27 to the BRDA. The transfer of process sand to the BRDA is covered by Section 4.3.1.8 of the plant Waste Management Manual (WM001).

### 5.3 Salt Cake

Salt cake is produced in the liquor purification/oxalate removal area of the process plant (A65). The liquor is purified through the precipitation of impurities that occur when the process liquor is concentrated. These impurities are removed as a filter cake, consisting principally of sodium compounds with carbonate, sulphate, oxalate, fluoride and chloride.

Salt cake is classified as a hazardous waste and is deposited within a section of the existing BRDA banded by red mud and process sand.

The disposal of salt cake is covered under Section 4.3.1.8 of the plant Waste Management Manual (WM001).

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#### 5.4 Lime Grits

These are the insoluble clinker cores of the burnt limestone cobbles dissolved in the lime slaking plant within the process. These are trucked from the process plant to the BRDA by the Contractor and are used as road surfacing materials in the immediate area around the salt cake.

The disposal of lime grits is covered under Section 4.3.2.6 of the plant Waste Management Manual (WM001)

#### 5.5 Process Scale

Process scale consists of hydrated sodium aluminium silicate sometimes combined with bauxite residues, removed from the interiors of process tanks, vessels and pipes during routine and turnaround maintenance activities in the process plant. All such scales are trucked by the Contractor to the BRDA and deposited on the existing red mud surfaces or on compacted process sand areas.

The disposal of scale is covered under Section 4.3.2.6 of the plant Waste Management Manual (WM001).

#### 5.6 Transport and Placement of Wastes

The BRDA is operated under the SPM Management Contract by Murphy International Ltd. who have overall responsibility for the collection, transportation, and placement of waste. The contract extends to maintenance and resourcing of all equipment, including vehicles, which operate within the BRDA, including environmental control equipment for dust suppression.

All residues are either pumped or trucked in specified skips or dumpers to the BRDA area. All drivers are trained to ensure that only wastes permitted for disposal in the BRDA should be contained in the designated skips. If other waste streams are contained in the skips the skips will not be removed for disposal. Drivers are also trained on checking and handling of leachate which may arise.

All trucked residues are transported to the BRDA area on a network of internal access roads constructed to engineering standards.

Trucked residues must be deposited on a layer of matured red mud. Process sand may be deposited directly onto red mud surfaces provided mechanical plant is confined to adjacent engineered designed and supervised access roads or the mobile plant is moving on a layer of compacted process sand.

#### 5.7 Relevant Standard Operational Procedures

In addition to the sections of the SPM Management Contract and the Waste Management Manual listed above, the following standard operating procedures (standard work methods) deal with the operation of the BRDA:

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**Table 3 Relevant SWM's**

Procedure Number	Purpose
SWM 2005	Wash Circuit Control
SWM 2006	Area 27A Operation
SWM 2009	Minimise Mud Soda Losses and Maximise Mud Density
SWM 2017	Pond Cleanouts and Inspections
SWM 2022	Area 54A Operation of the BRDA

## 5.8 Mud Farming Process

### 5.8.1 General Approach

The general approach to be taken is to practice what is called “mud farming”. Mud is deposited in separate drying bays or cells in the BRDA constructed using mud bunds or embankments as detailed on 54-G-1130 (see Appendix 1).

A screw-propelled amphirol (photo below) is used to plough the mud in the drying cells on a regular basis to accelerate and improve the natural drying process. This process is also used to maximise the atmospheric carbonation of the red mud residue by increasing the caustic soda / CO<sub>2</sub> interface contact.

This process continues until the increasing density of the mud residue reduces the effectiveness of the amphirol. A low ground pressure swamp dozer is then used to level the drying cell and reconstruct the cell walls.



*Amphirol used for mud farming*

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**5.8.2 Operations**

The BRDA Mud Farming operation consists of the following tasks:

- Residue Planning
- Filling the Drying Cells
- Drainage Management
- Mud Farming

Each of these systems is described below:

**Residue Planning**

The Phase 1 and 2 BRDAs have been subdivided into approximately 51 separate drying cells as detailed in the attached drawing 54-G-1130 (Appendix 1). Signs identifying each cell number as detailed on 54-G-1130 have been installed on the perimeter of the BRDA.

Mud is pumped to the drying cells via 3 pipelines aligned along the road to the Central Discharge Platform. A total of 19 separate discharge points have been installed on the pipelines to facilitate the filling of the drying cells in Phase 1 & 2 as detailed on 54-G-1130.

NB. Each discharge point is flushed before a period of non-usage (i.e. > 1 week) to prevent line restrictions and blockages. Mud Points 1 to 10 and 15 to 19 are flushed from the Central Discharge Platform using the recycled water. Mud Points 11 to 14 are flushed by injecting process condensate into the suction of the Area 34 Mud Pumps.

The BRDA Operations Team meets weekly and identifies the storage area required for the following week’s production and associated mud farming, drainage and maintenance activities.

Outer embankment walls are constructed in a timely manner, to ensure that residue storage area is available on a medium term (quarterly) basis in the BRDA.

Surveys of the BRDA are completed on a quarterly basis to estimate the ‘live’ storage volume available.

A weekly residue plan is issued each week, on BPI, to Local 2 and the SPF’s detailing the filling plan for the week. This plan details mud valve changes and alternatives in the event of pipeline maintenance requirements or valve problems.

**Filling the Drying Cells**

A 400mm – 500mm deep layer is filled into each drying cell in 200 – 250mm mud layers. A polymer hose is installed on each discharge point to allow the mud to be spread evenly across the cell.

Each cell is surveyed in advance by the SPM Management Contractor to identify, repair and raise sprinkler pipes as necessary.

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Cell filling is monitored by the BRDA Operations Team from 8am - 4.30pm Mon - Fri.

Cell filling is monitored by the L2 Process Operator and SPF's during the evenings / nights and at the weekends to ensure that filling is occurring according to the weekly residue plan.

### ***Drainage Management***

Drainage from the drying cells will initially be assisted by the long reach excavator to free the "bleed" liquor and rainfall from the cell. After approximately 7 – 14 days, the Amphiroil will complete an initial plough of the cell.

During this period the excavator will be required to maintain the drainage channels particularly around the embankment walls.

Additional drainage may also be required to eliminate areas of standing water at the perimeter of the BRDA.

### ***Mud Farming***

Mud farming will commence approximately 7 - 14 days after mud deposition has ceased. A daily inspection of all drying cells is required by the BRDA Operations Team.

The amphiroil continues to make passes over the mud cells every 3-7 days until the indentations in the mud reduce to < 5 – 10 mm. The cells are then re-built using a low ground pressure bulldozer with perimeter walls approximately 800mm - 900mm in height using mature mud.

### **Atmospheric Carbonation**

The atmospheric carbonation process commences immediately after the mud farming process has been completed. The mature red mud is initially ploughed to break up the compacted red mud surface. The ploughed red mud is then further reduced in size by harrowing to maximize the exposure of the caustic soda in the mud to atmospheric carbon dioxide.

The mud is then repeatedly harrowed on a daily basis until the pH is gradually reduced from an initial pH 12-13 until it is < 11.5.

In the event of a heavy rain forecast, the mud is rolled to seal the mud surface and prevent water ingress.

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## 6.0 Emergency Procedures

The management of emergencies is coordinated by a fully resourced and trained plant security team who are on site 24 hours per day, 365 days per year.

In the event of an emergency, the organisation of safety and emergency response is co-ordinated and located centrally at the security gatehouse (A79).

The overall plant Emergency Response Plan and procedures covers activities in the BRDA. The plant Emergency Response Plan deals with emergency preparedness, planning, response and co-ordination in the case of significant emergencies or incidents at the plant. The defined categories of emergency include environmental emergencies and emergencies which may have to potential to lead to environmental damage.

Environmental Emergency Response Procedure (P007.76.025) details specific measures to be taken in the event of a significant environmental incident at the plant in addition to defining roles and responsibilities in an emergency.

The main environmental emergency which can arise in the BRDA is dusting. It is classified as an emergency and is subject to formalised emergency response procedures (P007.02.012 Dust Emergency at the BRDA and P007.02.014 Severe Weather - Frost). Under the SPM Contract, the SPM Management Contractor has defined responsibilities in the event of dusting. These responsibilities extend from prevention to response through:

- Review of meteorological conditions
- Preventative damping of BRDA
- Maintenance of equipment
- Operation of sprinklers, bowsers
- Resourcing emergency response
- Communication with RUSAL Aughinish personnel in an emergency response
- Ensuring that relevant SWM's and Emergency Response Procedures are followed

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## 7.0 Dust Control

Historical evidence shows that incidents of fugitive dust generation occur under the effects of the following:

- Wind speeds in excess of 5 m/sec
- Freezing or very warm temperatures
- Dry air-conditions, i.e. low humidity

The primary objective in management of placement operations at the BRDA is to prevent the formation of conditions where fugitive dust generation can occur.

### 7.1 Dusting Prevention and Response Measures

The following fugitive dusting prevention and response measures are implemented at the BRDA.

1. Minimise mud flat area exposed to dusting risk by ploughing the mud surfaces via the mud farming process.
2. Keep mud flats in service (i.e. wet) as long as possible to limit areas of potential dusting.
3. Water spray (dust suppression) sprinkler system installed to ensure 100% coverage over red mud areas.
4. Ensure bowser units are available to transport and discharge water from the Liquid Waste Pond (LWP).
5. Bowsers should be left at the Liquid Waste Pond outside of normal business hours and where significant potential for dusting exists. If taken to be used elsewhere on site, must be returned cleaned to the Liquid Waste Pond and filled with water.
6. Open individual valves on sprinklers for approximately five minutes at a time and rotate as required.

The procedure to be followed in the event of dusting is SWM 2022.

### 7.2 Shannon Estuary Water Treatment Plant Roofs

Construction and covering of the roofs of the adjacent Limerick County Council Water Treatment Plant was completed in September 2011 in compliance with Condition 6.18 of the IPPCL.

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## 8.0 Surface Water Management and Protection

The BRDA is bounded by the River Shannon, the Robertstown River and Poulaweala Creek. The River Shannon is tidal at RUSAL Aughinish with a range of over 5m (spring tides).

Surface water runoff due to rainfall from the Phase 1 BRDA discharges to perimeter interceptor channel 1 (PIC 1). PIC 1 runs along the entire northern, western and southern perimeter of the Phase 1 BRDA.

Similarly surface water runoff due to rainfall from the Phase 2 BRDA discharges to perimeter interceptor channel 2 (PIC 2). PIC 2 runs along the western and southern perimeter of the Phase 2 BRDA.

PIC 2 is pumped into PIC 1 using a submersible pump with a capacity of 600m<sup>3</sup>/hr.

The runoff water is pumped from PIC 1 to the Storm Water Pond (SWP), located in the northeastern corner of the BRDA (adjacent to the Liquid Waste Pond) via a submersible pump with a capacity of 750m<sup>3</sup>/hr.

Two pumps are installed in the SWP to recycle surface water to the plant and to the effluent treatment system with a capacity of 375m<sup>3</sup>/hr each.

Surface water runoff is also recycled to the plant from PIC 1 by a submersible pump with a capacity of 750m<sup>3</sup>/hr. Surface water is treated in an effluent clarification system before ultimately being discharged to the River Shannon.

The Pumping capacity of the BRDA and Effluent Treatment system is attached in Appendix 2.

Short term heavy rainfall events in the BRDA are accommodated in the Perimeter Interceptor Channels (PIC 1 & PIC 2), Storm Water Pond (SWP) which have the following storage capacities:

- PIC 1 – 110,000m<sup>3</sup> plus 28,000m<sup>3</sup> freeboard.
  - PIC 2 – 68,000 m<sup>3</sup> plus 20,000m<sup>3</sup> freeboard.
  - SWP – 182,000 m<sup>3</sup> plus 60,000m<sup>3</sup> freeboard.
- Total – 360,000m<sup>3</sup> plus 108,000m<sup>3</sup> freeboard.**

This design storage capacity is sufficient to ensure a 1 in 200 year rainfall event can be safely managed within the system, while allowing treated effluent discharges to remain within daily flow limits as specified in the IPPC Licence (Schedule 2(ii)).

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## 9.0 Groundwater Management and Protection

Aughinish Island is hydro geologically isolated from the mainland and can be regarded as an independent groundwater body.

The BRDA is underlain by two geologically dissimilar components. The northern part of the Phase 1 BRDA is generally underlain by low conductivity estuarine deposits, which are subject to saline intrusion (with the water table). The original plant BRDA was developed directly on this material.

The eastern part of the Phase 1 BRDA is underlain by limestone bedrock. This section of the BRDA is sealed within 1.0mm and 2.0mm thick HDPE sheets, on 600mm of screened glacial till.

The Phase 2 BRDA is underlain by estuarine deposits on the west side and by limestone bedrock on the eastern side. The Phase 2 BRDA is sealed within 1.5mm and 2.0mm thick HDPE sheets, on a layer of geosynthetic clay liner (GCL).

### 9.1 Groundwater Seepage Controls

The original northern part of the BRDA was developed over an extensive deposit of low hydraulic conductivity estuarine soil. In addition, the upstream slope of the outer wall around the BRDA and the SWP was sealed with a composite liner consisting of a 750 mm thick compacted glacial till fill covered with a 2.0 mm thick HDPE liner anchored in the estuarine soil along the toe of the Outer wall. In addition, all areas along the toes of the Outer wall where the estuarine soil thickness is less than 4.0 m (applies to the BRDA) or where glacial till or rock outcrop (applies to the SWP) was encountered, were sealed with 2mm thick smooth HDPE liner. All runoff reporting to the open drainage ditch is stored between the Outer wall and the Rockfill Starter Dyke (RFSD).

The extended southern part of the BRDA is sealed with 1.0 and 2.0 mm thick smooth and double textured HDPE sheets. Beneath the HDPE sheets, the subgrade consists of a series of mineral varying from 300mm to 600mm thick depending on the subgrade.

### 9.2 Seepage/Leakage Management and Control

The following seepage and leakage control systems are in place:

(1) Collection and pumping back to the open perimeter drains of identified localised and concentrated seepage sources, e.g. around the northwest corner of the original BRDA.

(2) A leak collector toe drain along the northern and northwestern edge of the BRDA. Leachate intercepted by the toe drain is routed to a sealed concrete sump from where it is pumped into the SWP or into the Perimeter Channel.

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### 9.3 Landfill Gas

The bauxite residues are inorganic therefore there is no landfill gas generated by the placement of the residues.

### 9.4 Gabion Mattress Protection of the Outer wall

Installation of a gabion mattress on the downstream slope of the outer wall of the Phase 1 and 2 BRDAs is currently under construction and will be completed by October 2013.

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## 10.0 Leachate Management and Disposal

The BRDA does not generate leachate in the conventional sense of the term (as applied to waste disposal) due to:

- a) The bauxite process residues placed within the BRDA are inorganic and do not degrade.
- b) The red mud on placement and maturation has hydraulic conductivity values of the order of  $1 \times 10^{-9}$  m/sec. Accordingly, recharge and downward movement of liquid into the waste (through precipitation) does not occur.

Although there is no positive leachate collection system in place, washout or bleed water from the red mud is collected in the perimeter channel and returned to the plant for treatment and licensed discharge.

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## 11.0 Life Expectancy

The existing Phase 1 BRDA consists of the original BRDA and the Phase 1 extension, which have been merged since 1999. As the rate of placement is a direct function of production activity, the life expectancy of the BRDA will be reduced with increasing levels of production.

Following the commissioning of the Phase 2 BRDA in 2011, the life expectancy of the combined Phase 1 and 2 BRDAs has been increased by 22 years until 2033, based on current production levels and waste generation levels. This is reviewed each year as part of the AER. Further details are provided in Section 3 of the 2013 AER.

The calculated remaining capacity of the BRDA is detailed in Table 46 of the 2013 AER.

## 12.0 Restoration

A Decommissioning and Closure Plan for the site was prepared by SRK Consulting Ltd. and Enviroplan Services Ltd in 1999 – this included proposals for the restoration and aftercare of the BRDA. The Plan was submitted to the Agency as part of the first plant AER in 1999. A revised plan taking into account the Phase 2 extension to the BRDA was submitted in 2005 as part of the application for a revised IPPC Licence. The plan is updated annually and the most recent update was submitted to the EPA in December 2010.

Based on research undertaken to date, it is proposed that the BRDA will be rehabilitated both in the interim (2103) and following final closure of the facility by establishing a surface vegetation cover to ensure physical and chemical stabilisation of the stored bauxite residues.

Establishment of vegetation on the bauxite residues stored at the BRDA has been successfully demonstrated by greenhouse and field trials carried out in conjunction with the University of Limerick. To achieve this, amendment of the residue (using gypsum and process sand) is required and an understanding of the basic physical and chemical principles for reclaiming alkaline residues must be established. Considerable attention has been focused on the testing and measures that can be used to ensure appropriate surface soil conditions are present which will promote successful vegetation establishment and surface rehabilitation of the BRDA while controlling costs.

Engineering proposals to address the drainage, seepage, control of storm water and surface run-off from the BRDA both in the interim and following final closure of the facility have been investigated and designed by AAL’s consultant Golder Associates.

### 12.1 Closure and Restoration Programme

Closure will involve utilisation of those techniques that have been proven in operations, or demonstrated in field trials, which have the greatest potential to achieve the performance criteria for air, soil, surface water and groundwater. A key element of this closure plan will be the rehabilitation cover for the BRDA. Because of the variety of

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wastes within the BRDA, there are several different surface treatments which will be necessary in order to ensure that performance criteria are achieved following closure.

The BRDA will be rehabilitated to ensure physical and chemical stabilisation of the red mud. The newly created soil (red mud mixed with process sand, gypsum and organic waste) will be seeded with a grassland seed mixture, and fertiliser applied by broadcast spreader. AAL propose to achieve self-sustaining vegetation cover after a period of five years. It is proposed that through delivery of 'completion criteria' sustainability of the vegetation cover system can be demonstrated.

Steps will be taken to ensure that a suitable drainage system is established on the rehabilitated BRDA. Engineered surface water drainage berms will be created to allow for stormwater drainage. Careful supervision will be provided during final mud deposition on the BRDA to ensure the surface topography remains consistent for the construction of a system to direct surface water and lateral seepage safely off the BRDA.

The maintenance of efficient surface water drainage from the BRDA, avoiding as far as possible soil erosion into the perimeter channel, will contribute to the improvement of water quality after closure. With time, it is expected that rainwater flushing and wet-dry cycles in the surface layers of the BRDA, will improve water quality so that runoff and seepage can be discharged without treatment.

## 12.2 Interim Restoration

As part of the extension of the BRDA, an interim restoration plan will be put in place to provide for intermediate cover of the perimeter embankment slopes as the height of the area is increased. This will involve the installation of a mud drain just below the operating mud stage, which will intercept and drain water in a controlled manner to the Perimeter Interceptor Channel. Construction of this drain was completed in 2012 in advance of the landscaping works in 2013. Each of the stages on the Phase 1 and Phase 1 Extension will then be improved by infilling the external step with a drainage medium and topsoil, thereby giving the BRDA the appearance of a sloped and domed hill.

## 12.3 Timeframe

Table 5 shows the proposed fill dates for each phase of the BRDA. Restoration of the BRDA will be carried out on a phased basis. Interim landscaping of Stages 1-8 side slopes in the Phase 1 BRDA will be completed in 2013 and will include design features to allow for the further restoration and closure of the entire BRDA. The southern face of the Phase 1 BRDA Stages 1 to 7 will also be landscaped, though it will be later obscured by progressive filling of the Phase 2 BRDA. Landscaping of Stages 1-6 of the Phase 2 BRDA will occur after Stage 6 is constructed. It is estimated that the entire BRDA will reach capacity by approximately 2034. Following full closure, all remaining Stages and the domed surface of the BRDA will be restored.

**Table 5 Timing of Stages in the BRDA**

Date	Phase 2	Phase 1	Phase 1 Extension
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2012	Fill Starter Dam	Stage 9	Stage 8
2013	Fill Starter Dam	Stage 9	Stage 8
2014	Stage 1	Stage 9	Stage 8
2015	Stage 1	Stage 9	Stage 9
2016	Stage 1	Stage 9	Stage 9
2017	Stage 2	Stage 9	Stage 9
2018	Stage 2	Stage 9	Stage 9
2019	Stage 3	Stage 10	Stage 10
2020	Stage 3	Stage 10	Stage 10
2021	Stage 4	Stage 10	Stage 10
2022	Stage 4	Stage 10	Stage 10
2023	Stage 5	Stage 10	Stage 10
2024	Stage 5	Stage 10	Stage 10
2025	Stage 6	Stage 10	Stage 10
2026	Stage 6	Phase 1 Extension full	Phase 1 Extension full
2027	Stage 7	Restore Phase 1	Restore Phase 1
2028	Stage 7		
2029	Stage 8		
2030	Stage 8		
2031	Stage 9		
2032	Stage 9		
2033	Stage 10		
2034	Phase 2 Extension full		

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## 13.0 Aftercare Management

### 13.1 Aftercare Monitoring

Success of surface re-vegetation (which will be critical in meeting requirements for control of fugitive dust and valuable in the limitation of subsurface seepage and the maintenance of geotechnical stability) will be measured on the basis of vegetation and soil biological surveys. These surveys will be conducted annually until Year 5 upon which time it is anticipated that the re-vegetation programme will be deemed successful. Should the five-year objective not be met, AAL will identify the measures that it will undertake to improve the performance of the cover.

At closure, the water sprinkler system will continue for a limited period, particularly throughout any periods of leaching and weathering, until surface rehabilitation by a vegetated surface cover is established. The long-term suppression of fugitive dust will be achieved by installing a vegetation cover with sufficient density to retain the residue material.

Water treatment will no longer be considered necessary when the pH in the perimeter channel is maintained at less than or equal to pH 9 with a Total Suspended Solids (TSS) of less than 50 mg/l for 90% of the samples taken over a 12-month period. Following attainment of water quality objectives for a one-year period without treatment, the water management system will be decommissioned. The perimeter channel and the SWP can then be breached (with spillway and sluice constructions) to allow for direct discharge to the Shannon Estuary via the Robertstown River. It is anticipated that this can be achieved within five years post-closure.

Monitoring of surface water quality and groundwater quality in the vicinity of the BRDA will continue for a period of up to 30 years post closure.

To monitor geotechnical stability, for five years after the closure of the BRDA, AAL will conduct periodic monitoring of subsoil moisture, to demonstrate that the suction head for the upper subsoil layers is being maintained, or reduced, as a result of the rehabilitation measures.

### 13.2 Final Land Use

The preferred land-use option for the BRDA, based on current knowledge of the chemistry and biology of the sown grassland cover, is to develop the area for nature conservation. A section of AAL land to the north of the BRDA has already been developed as a Bird Sanctuary, so the development of a nature conservation area is in keeping with AAL land conservation practices. The bird sanctuary management has been featured and reported on by organisations such as the Irish Wildbird Conservancy since its development in 1981.

The choice of end-use is also in line with procedures in the 2004 EU BREF on Tailings Management where it states that *'rehabilitation is such that the ultimate land use is optimised and is compatible with the surrounding area and the requirements of the local community'*.

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Lands adjacent to the AAL facility are subject to EU and national environmental designations and the sensitivity of these environmental receptors, particularly in the key areas of surface and groundwater quality, have been taken into account in the design of the BRDA restoration and aftercare process.

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## 14.0 Environmental Monitoring Programme

RUSAL Aughinish undertakes extensive monitoring of environmental quality (air, water, groundwater, dust and noise) in the vicinity of both the plant and BRDA in accordance with the requirements of our IPPCL.

This monitoring, which is undertaken by qualified and experienced Environmental Technicians is detailed in SWM 0003 IPPCL Compliance and Environmental Performance Monitoring and Reporting.

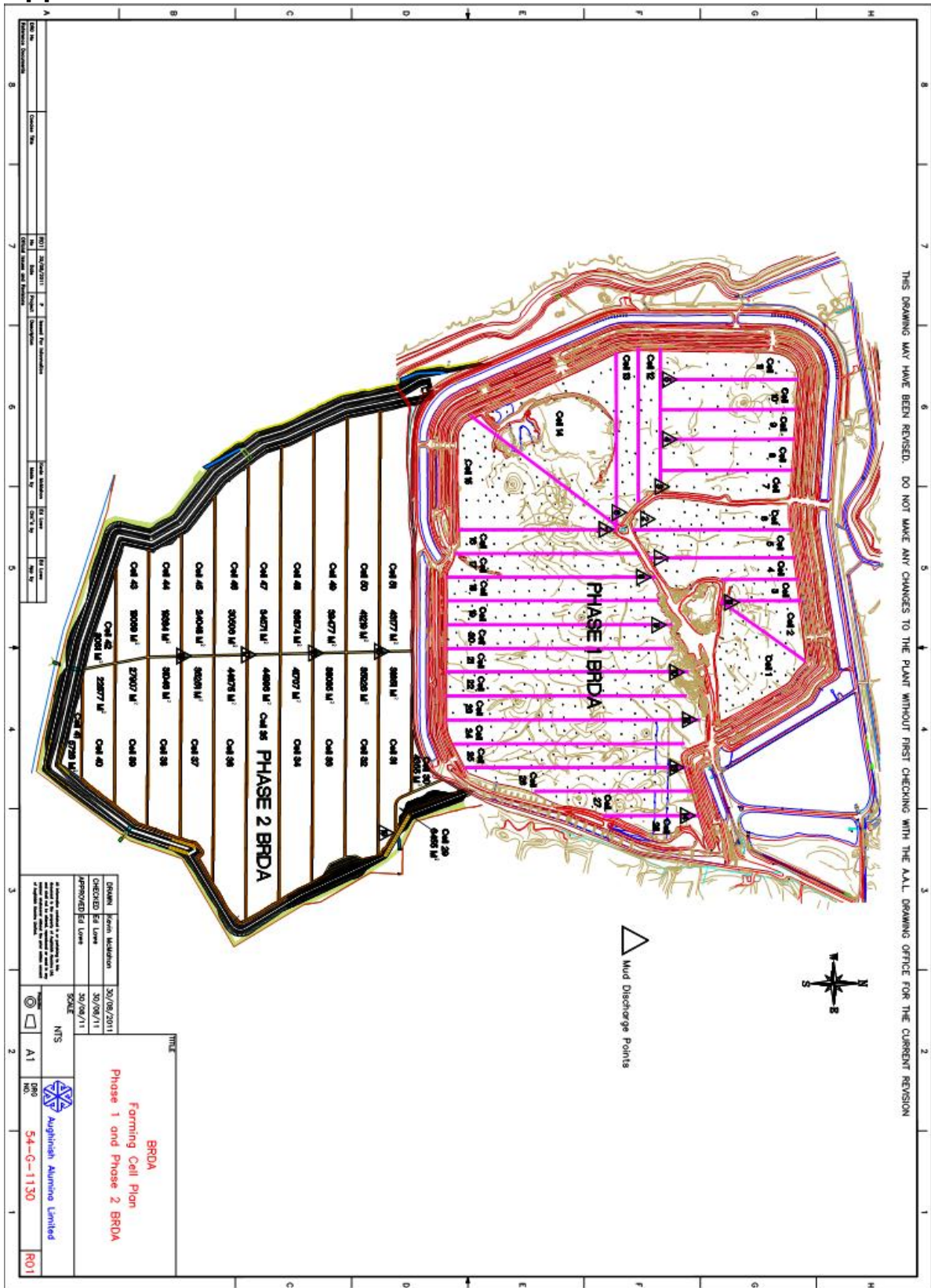
**Table 6 Environmental Monitoring in the BRDA**

Environmental Media	Monitoring Location	Analysis Undertaken	Frequency
Surface Water	OPW Channel Mangans Lough	pH, Conductivity, Soda	Monthly
Groundwater	BRDA Observation Wells (OW's)	pH, Conductivity, Total Alkalinity, Fluoride, Chloride, Soda, Heavy Metals	Quarterly
Air – Fugitive Dust	Dust Gauges at perimeter of BRDA	Dust Deposition	Monthly
Noise	Boundary Locations around BRDA: North Shore (B5), East of East Ridge (B4)	Sound Pressure Level, L <sub>AEQ</sub> , L <sub>A10</sub> , L <sub>A90</sub>	Annually
Waste	Red Mud, Sand, Salt Cake, Leachate	pH, Dry Matter, Alkalinity, Chloride, Fluoride, Soda, Metals	Monthly

In addition to the above, RUSAL Aughinish maintain a weather station between the plant and the BRDA for measurement of wind speed, direction and temperature. This data is fed back to the plant Process Information (PI) System. Recorded data is used for historical look back purposes and in incident investigation.

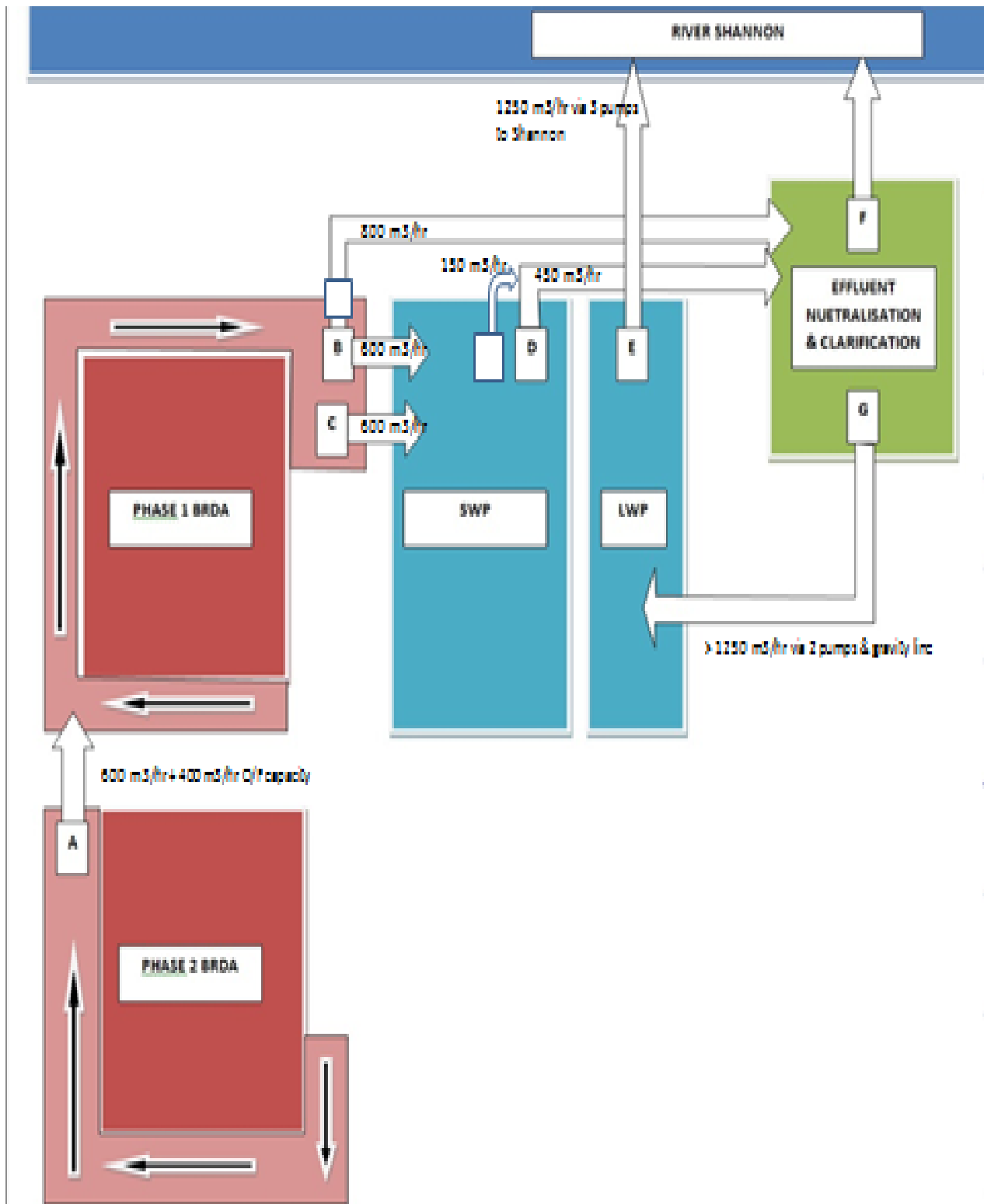
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### Appendix 1



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## Appendix 2



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## **Attachment 7**

# **BRDA Closure Planning & Re-vegetation**

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### **Closure Planning**

Address some gaps in the understanding of the surface water quality in the closure plan. Improve the long-term predictions of water quality, by a better understanding of residue leachate chemistry and by conducting a more comprehensive assessment of the residue permeability and leaching characteristics. This is not an urgent action; however, it will take a considerable period to determine with precision. It is recommended that:

1. *Clear confirmation of the likely starting pH of the residue for all leaching testing. In the documentation reviewed and recent experiments there is over 1 unit difference in pH. While this may appear to be a minor issue it impacts on the predicted alkalinity leaching rate and potential effluent water quality.*

Successful employment of the mud farming practice on the BRDA promotes carbonation of the red mud within the BRDA resulting in partial neutralisation to a stable pH around 10.5.

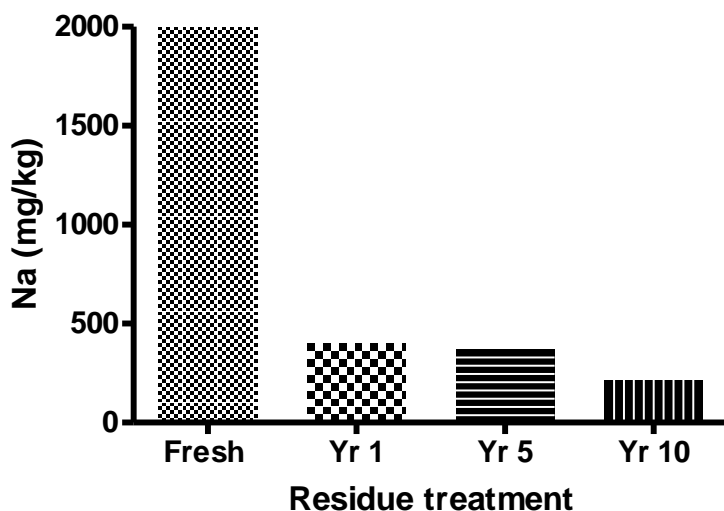
2. *Make a more thorough assessment of the rainfall variability and impact on surface water quality with emphasis on the likely leachate quality variation and impacts on the proposed management approach.*

Leachate quality and run-off will be monitored within the recently established trial cell demonstration area. Surface run-off quality data from revegetated area will be collected and all leachate/ run-off data will be included in model for water quality operation of a constructed wetland treatment cell.

The effects of dilution rates and water quality on BRDA leachate pH and alkalinity are being assessed as part of the constructed wetlands project.

3. *The effluent water quality variability is also likely to be influenced by the run-off water quality of the vegetated surface and the rate at which organic material or gypsum will need to be added to ensure maintenance of a growth horizon in the residue. A detailed review of the changes in surface water quality in response to the management practices required to sustain the re-vegetation is required.*

Results from 5yr old revegetated residue show that organic matter is accumulating and that Ca content in vegetation is not deficient. Continuous monitoring of vegetated residue physico-chemical conditions will determine if conditions deteriorate to an extent where supplemental gypsum application is required. Findings thus far indicate that the decrease in exchangeable sodium achieved for vegetation establishment has been successful and levels decrease further (Fig. 1). Supplemental gypsum/ organic matter addition is not anticipated in such a scenario.



**Figure 1. Exchangeable sodium in fresh bauxite residue and in restored residue over a 10-yr sampling period**

4. *A long-term or accelerated freshwater leaching of residue column study is required to confirm the leachate chemistry and provide data to support the theoretical position. This program should include a thorough investigation of the alkalinity leaching chemistry. If possible, the opportunity to conduct a core drill should be considered to examine some of the initial residue placed by the plant before 1985 as this would have had an opportunity to leach for over twenty years.*

Collection of leachate data from the trial cell is summarised below (Table 1). Residue leachate pH, conductivity and soda content have all increased over the 4 year sampling period. Leachate collected over this period is composed of entrained liquor from the residue that was pumped to the cell at high soda and moisture content (due to plant operational conditions at time). However, this cell has recently been pumped dry and future samples should therefore be of recharge of residue with fresh percolation leachate and influenced by the vegetation cover now growing on amended residue surface.

**Table 1. Selected properties of BRDA trial cell leachate**

	pH	EC ( $\mu\text{s}/\text{cm}$ )	Na <sub>2</sub> O (g/l)
May-07	12.62	26710	9.6
Sep-07	13.02	37100	11.3
Mar-11	13.24	67400	16
Sep-11	13.22	68300	16.5

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5. *An appropriate statistically robust permeability monitoring program followed by a probabilistic approach to the estimation of vertical and horizontal permeability is required to provide confidence limits around the anticipated surface water dilution flows. This information will ensure the modelling precision exists to develop reasonable confidence in predicting when the effluent water quality objective will be met.*

This has yet to be undertaken.

6. *Given the uncertainty in the effluent water quality, specific research is required as part of AAL's ongoing BRDA Closure Plan to address the potential for pH control beyond the budgeted 5 years of operation of the run-off neutralization plant. Pending confirmation of the leachate chemistry over time via the Closure Demonstration Cells it would be prudent to consider development of a wetlands or similar facility to trim the final pH of the run-off prior to final discharge.*

### **Constructed wetland.**

Constructed wetlands are designed and built for specific purposes and are recognised as effective remediation technology for a wide range of polluting effluents. Use of constructed wetlands to treat alkaline leachates has recently been demonstrated in both literature and industrial site visits, and the potential exists for similar concepts for alkaline bauxite residue leachate. Preliminary trials have demonstrated the potential for wetland type substrates to buffer alkalinity in synthetic residue leachate.

Rusal Auginish has been successful (February 2012) in obtaining research funding from the International Aluminium Institute (IAI) to implement a pilot wetland to treat residue leachate. The pilot wetland cell has been constructed on the BRDA and planted with wetland vegetation (*Phragmites australis*, *Typha latifolia* and *Sparganium erectum*) (Plate 1). The constructed wetland ecosystem will require a minimum of one-year for establishment before receiving BRDA leachate. A PhD study has commenced (September 2012) using complimentary laboratory based batch trials to investigate mechanisms that occur within wetland systems.

- Dilution effect on leachate alkalinity
- The effect of organic matter in buffering leachate alkalinity
- The effect of CO<sub>2</sub> in buffering leachate alkalinity

Anticipated leachate quality at closure will be diluted by surface run-off from the amended and restored BRDA. A leachate dosing system that will simulate closure quality leachate is currently gone to tender. The system will be comprised of a series of tanks the will mix BRDA leachate with water to a predetermined pH and is anticipated to be in place by early summer.

This pilot constructed wetland study will be well placed to examine the temporal variability of both surface runoff and BRDA leachate generation.



**Plate 1. Wetland cell constructed on BRDA. Vegetation is currently in the establishment phase.**

7. *As all land-forms are susceptible to erosion, the potential erosion risk of the post-closure BRDA should be assessed and modelled under a range of potential scenarios.*

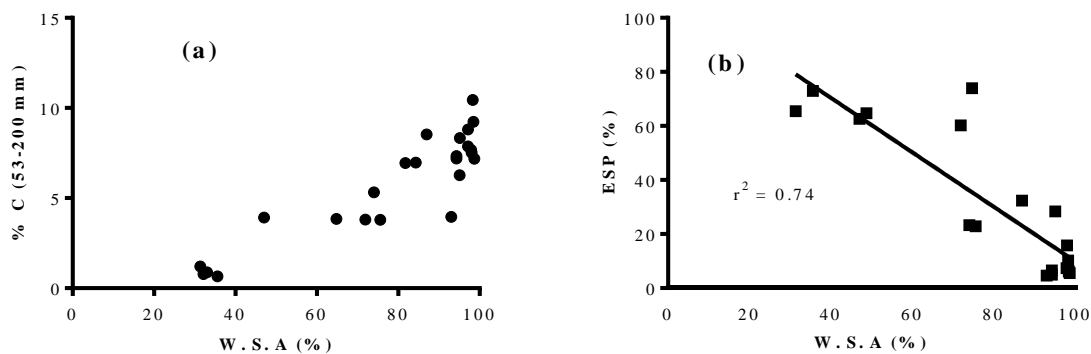
In its unamended state the fine fraction residue (red mud) lacks aggregation. This lack of structural stability can promote seal and crust formation at the soil surface, resulting in erosion. Furthermore, structural problems created by physical processes such as dispersion of clay minerals and specific conditions such as surface crusting and hardsetting may affect water and air movement, plant-available water-holding capacity, root penetration, seedling emergence and tillage and sowing operations.

Table 2 illustrates the effect of the amendment and restoration process in improving residue physical properties. Texture of unamended residue is dominated by fine particle size (silt and clay) leading to poor physical quality as a growth medium. Amended and restored residue exhibits properties analogous to soils taken from adjacent unmanaged grassland from within the refinery site. Further, initial decreases in residue pH and EC from the restoration process are further improved over time, illustrating the overall soil development that occurs in the residue.

Due to the high exchangeable sodium (ESP) content of the mud, dispersion is the driving force controlling the breakdown of microaggregates, resulting in immediate production of dispersed clay.

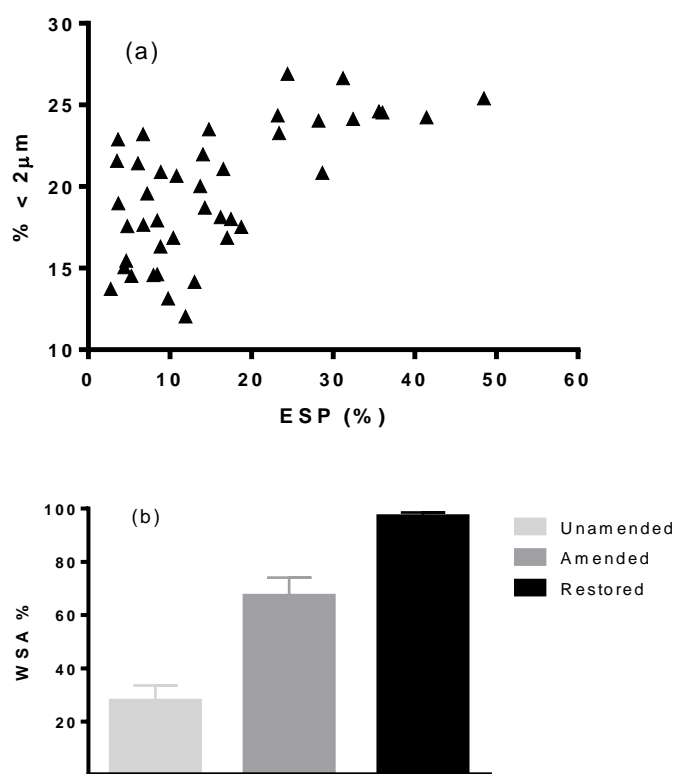
Gypsum and organic matter applications are used in the restoration process on the residue. The basis of microaggregate (<250 µm) formation in soils is flocculation of soil colloids through the formation of clay–organic matter complexes linked together by polyvalent cations and it is recognized that gypsum has a role in flocculating clay particles in soils and is effective in stabilizing aggregates under 250 µm.

Formation of aggregates is important in the formation of soil structure since the pores within and between aggregates provide for gaseous exchange, water storage and transport as well as serving as microhabitats for soil biota. The stability of the porous structure is dependent on the stability of aggregates. Thus water stable aggregation (the ability of aggregates to withstand the slaking and dispersive effects of water) is an important structural property. Effect of residue physico-chemical parameters (carbon content and ESP) on aggregate stability is shown in Figure 2. Water stable macro aggregates (> 250 µm) of different residue treatments are shown in Figure 3b.



**Figure 2. Relationship of residue C content (a) and ESP (b) with water stable macroaggregates (W.S.A.)**

The monitoring programme for the restored BRDA includes the residue physical properties and factors influencing them eg. ESP, organic matter, pH and microbial biomass.



**Figure 3a – Relationship of residue exchangeable sodium (Na) with dispersible clay content**

**Figure 3b – Water stable aggregates (WSA) proportions in different residue treatments**

**Residues Solutions Report - Recommendations (Condition 8.4.17) – Update March 2013**

	<b>Bare Residue</b>	<b>1 yr old restored residue</b>	<b>10 yr old restored residue</b>	<b>‘Natural’ Soil</b>
Sand (%)	13.3	68.9	69.5	67.7
Silt (%)	45.4	20.3	22.8	29.1
Clay (%)	41.4	10.9	7.8	3.1
Texture	Silty clay	Sandy loam	Sandy loam	Sandy loam
pH	10.1	8.2	7.4	7.3
EC (mS/cm)	3.1	0.96	0.36	0.33
Particle density (g cm <sup>-3</sup> )	3.42	2.6	3.2	2.68
Bulk density (g cm <sup>-3</sup> )	1.34	0.81	1.1	0.87
Porosity (%)	59	69	65	67
(Macro) Aggregate Index (WSA)	27	71	97	97
Mean diameter dispersed microaggregates (<53 µm )	9	12	19	23

Table 2. Selected physico-chemical properties of the bauxite residue treatments (bare, unamended residue and restored residue over time).



**Plate 2.** Examples of residue lacking of structure with increased erodibility risk in unamended residue (right) and formation of soil structure in restored residue (left)

### Closure - Revegetation

8. *It is likely that the sustainability of the proposed re-vegetation on a stable, naturally draining residue deposit will be dependent on several key issues. Further experimentation is required to examine the sustainability of the revegetation by:*

*8a. Ensuring that there are sufficient nutrients for the re-vegetation and that the cycling of nutrients develops to a self-sustaining level enabling input of new nutrient sources to be minimized. A review of the cycling demands of these nutrients, amendments and the relationship with the surface water quality is required.*

### **Nutrient supply**

Findings from the BRDA trials and international literature review on unamended residue are summarised. Organic matter (organic C, total N) content of unamended bauxite residues is very low and N additions as inorganic fertilizer and/or organic waste need to be applied. Extractable, plant-available P levels are also very low and Deficiencies of Ca, Mg and K can also occur in unamended residue since the dominant exchangeable cation is Na. Micronutrient fertilizer additions (particularly Zn, Cu, and Mn) are also required. A review of international literature on bauxite residue restoration yields findings in agreement with findings here.

Furthermore, results and recent international residue literature has cited the shortcomings of total elemental analysis and some standard agronomic soil tests for application on mine residues, including bauxite residue. Comparison of standard soil tests for assessing nutrient availability in amended residue is ongoing.

e.g Plant available Phosphorous in; Courtney, R. and Harrington, T. (2010) Assessment of plant-available phosphorus in a fine textured sodic substrate. *Ecological Engineering*. 36: 542-547

Nutrient supply through organic matter additions with supplemental inorganic fertilisers is the standard practice for revegetation of the BRDA.

In order to test the effectiveness of amendments at promoting revegetation, bauxite residue was amended with varying rates of compost to increase fertility (0, 60, 80 and 120 t ha<sup>-1</sup>) and gypsum to reduce sodicity (0, 40 and 90 t ha<sup>-1</sup>). Amended residue was sown with *Holcus lanatus*, a perennial grass. Following a 1-year growth period, substrate properties, plant performance and plant nutrient uptake were assessed. Compost application substantially increased substrate N, P, K and Mn concentrations, while gypsum application greatly reduced sodicity and improved nutrient uptake for Mn and P. Compost amendment was essential for sustainable plant growth. Foliar deficiencies in N, P and Mg may persist with lower compost application rates, requiring the addition of supplemental fertiliser for healthy plant growth.

Whilst land application of organic wastes (biosolids) can supply appreciable N and P, nutrient levels in amended residues will depend on the type of waste applied and application rate. With sufficient organic amendment, plant nutrient content in restored residue are within typical ranges reported for grasslands (Table 4).

**Table 3. Selected residue substrate parameters for different treatments and desired range for plant growth**

	Unamended	SMC 0 t ha <sup>-1</sup>	Amended		Desired range
			SMC 60 t ha <sup>-1</sup>	SMC 120 t ha <sup>-1</sup>	
N (g kg <sup>-1</sup> )	n.d	n.d	0.05	0.10	
P (mg kg <sup>-1</sup> )	<5	<5	6.9	9.1	
C (%)	n.d	0.96	1.6	2.3	
Mn (mg kg <sup>-1</sup> )	n.s	0.34	1.14	2.27	1-5
Zn (mg kg <sup>-1</sup> )	n.s	0.31	1.12	2.27	0.2-2
Cu (mg kg <sup>-1</sup> )	n.s	0.25	0.36	0.54	0.1-2.5

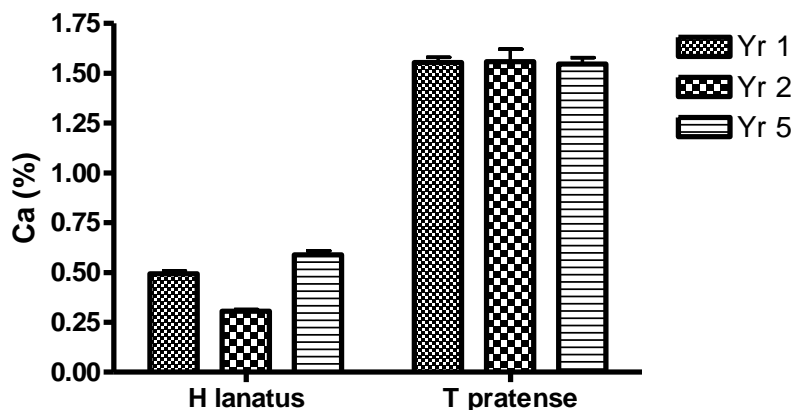
SMC = Spent Mushroom Compost;  
n.d not determined – below range, n.s. not sampled

**Table 4. Nutrient range in *Holcus lanatus* growing on restored residue and typical range for grasslands.**

	Bauxite Residue Range	Typical range**
N (%)	1.5 – 3	1 – 5
Ca (%)	0.57 – 0.93	0.33 – 0.73
P (%)	0.27 – 0.40	0.1 – 0.6
K (%)	2.2 – 4.5	2.16 - 4.01
S (%)	0.23 – 0.38	0.15 – 0.6
Mg (%)	0.13 – 0.19	0.08 – 0.26
Zn (mg /kg)	15.6 - 29.2	10-14

*Nutrient cycling and soil biota*

Nutrient cycling in the restored residue is being assessed through physico-chemical parameters such as nutrient pools in the residue and plant content and biological assays including soil biota and plant litter decomposition, microbial communities, enzyme activity, and carbon respiration. Plant Ca content for two species over a five year monitoring period is shown below (Figure 4).



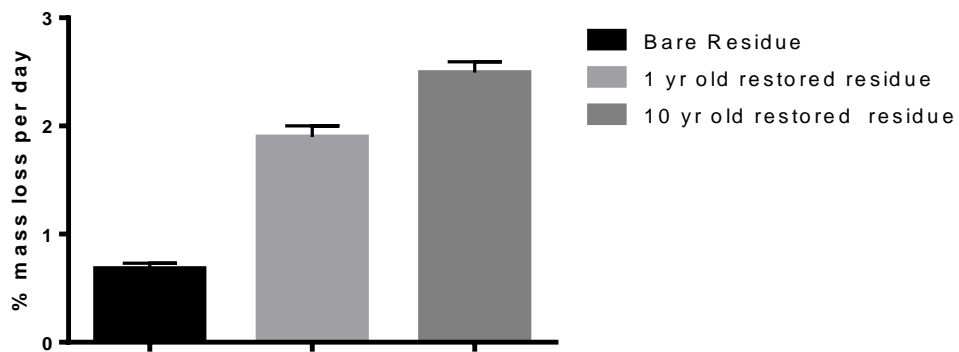
**Figure 4.** Ca concentration in *Holcus lanatus* and *Trifolium pratense* growing in amended and restored residue over a five year period.

Nutrient cycling within the restored residue areas is demonstrated through the use of litterbags. Here, plant litter is placed within mesh of varying aperture size permitting or excluding entry of soil biota. Loss of mass within the litterbag infers consumption and degradation of the plant litter by the soil biological community. Plate 3 (below) illustrates the litterbag methodology. Litterbags are employed in the restoration treatments (including bare residue) and differences sites and seasonal variations are assessed. Results in Figure 5 are seasonal averages for 2012. The decrease in plant litter mass placed on bare residue is explained by its attraction to the invertebrates established in restored areas. Significant increase is observed within one year of restoration, illustrating rapid colonisation by soil biota. The older restored site has significantly highest mass loss as a result of supporting a more diverse soil biota community (Figures 6 and 7).

Keystone soil biology species indicative of stable ecosystems have been identified in revegetated residue e.g. certain earthworm/ soil nematode groups. Factors controlling the colonisation and survival in the bauxite residue are being assessed.



**Plate 3.** Plant Litter experiment. Aperture sizes permit entry of macro-invertebrates.



**Figure 5.** Plant litter mass loss (decomposition) in the different residue restoration treatments

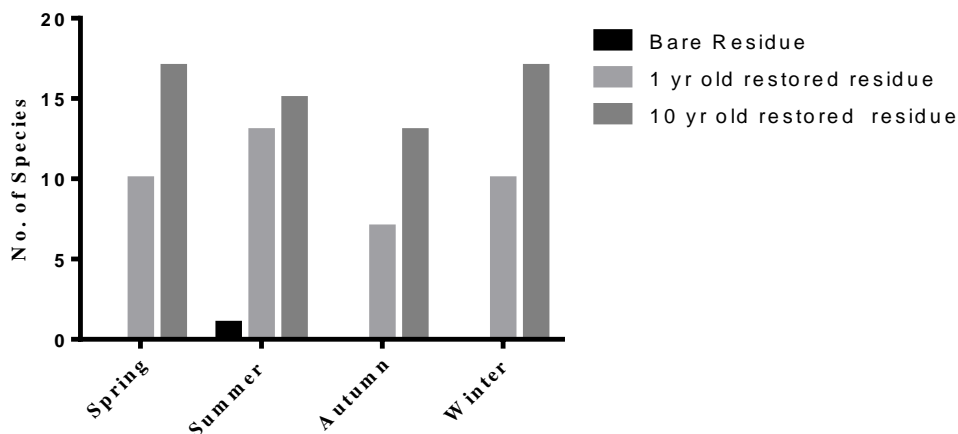


Figure 6. Macroinvertebrate diversity in the bauxite residue treatments.

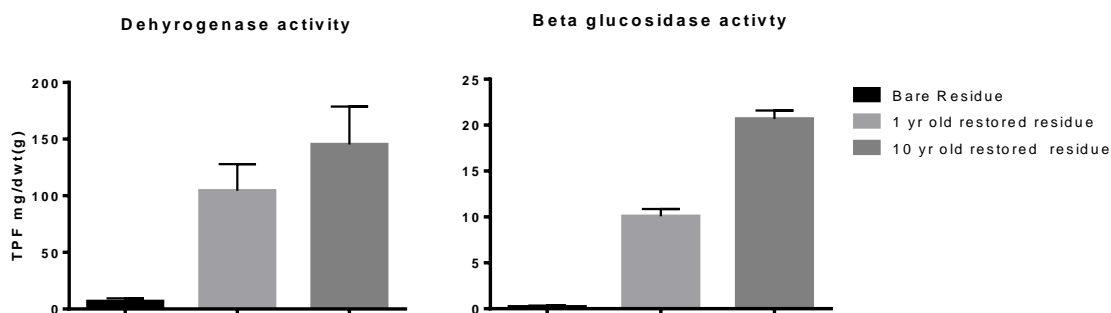


Figure 7. Increasing microbial activity over time indicating nutrient cycling.

Functional potential of microbial communities in the residue was evaluated by measuring extracellular enzyme activities. Dehydrogenase activity, which reflects overall microbial activity in the residue substrate, and  $\beta$ -glucosidase activity is related to the carbon cycle, and fulfils a central role in the cycling of organic matter. Activity of both enzymes is negligible in bare residue. Amendment of residue and sustained plant growth leads to increase over time in the respective enzymes activity illustrating microbial function and nutrient cycling. Limiting factors to enzyme activity and restoration management techniques to promote activity is an ongoing area of research on the BRDA.

## Residues Solutions Report - Recommendations (Condition 8.4.17) – Update March 2013

- 8b. *Ensuring that there is a suitable post-closure monitoring and control within the overall Closure Plan to address nutrient needs, erosion control, prevention of burrowing animals and controlled human access.*

A post-closure monitoring programme is being developed for assessing success of residue restoration in the Closure Plan

A monitoring programme that will assess the functioning ability of the restored residue has been developed. The following 'Completion criteria' will be periodically assessed and, where necessary, management intervention implemented. A sampling and monitoring programme is now in place that assesses the success of the residue restoration. Key components include;

- i. Vegetation establishment, survival and succession
- ii. Vegetation productivity, sustained growth and structure development;
- iii. Soil fauna colonisation and habitat development;
- iv. Ecosystem processes such as soil development and nutrient cycling,
- v. Colonisation of specific fauna groups that are involved in these processes
- vi. Microbiological studies e.g. colonisation by mycorrhizal fungi and microbial biomass
- vii. Ecosystem recovery

For example, collated data on residue Ca, ESP, pH, organic content and microbial biomass alongside micro and macro aggregate content will be used to assess erosion resistance.

Post closure

9. *The current design does provide some flexibility in the post-closure land-use. It should be emphasised that the proposal of a land-use supporting ‘Amenity’ is a minimum objective. The potential exists for limited carbon-capture or fodder cropping given sufficient time and organic resources to construct a suitable growing zone on the residue surface. Further investigation into both the carbon capture (Carbon dioxide capture in grasses) and fodder cropping (harvesting of vegetation to supplement off site livestock feed) is recommended.*

**Fodder crop**

A field trial was used to investigate the potential for fodder crops to be grown on the amended residue. On residue exhibiting pH <8.2 and ESP < 9 alongside nutrient supply a *Lolium perenne/ Trifolium repens* grassland mix was seeded. Following a growing season, a one-cut assessment of its fodder quality was determined. A range of values are shown (Table 5).

<b>Parameter</b>	<b>Range</b>
Dry Matter Content (%)	11.5 - 17.6
Total Crude protein (%)	18.8 - 28.4
MAD Fibre (%)	22.4 – 25
Digestibility (D value)	72 – 75
Metabolisable energy (MJ/kg)	11.3 - 11.8
Digestible crude protein (g/kg)	133 - 219

Table 5. Fodder quality of vegetation harvested from amended and seeded residue

Compared to typical values determined for Irish fodder crops. Fodder quality from amended residue is summarized. It has very high crude protein content and a reasonable digestibility. These results compare to excellent grass silage of 20-30 % DM, 15-16 % crude protein and 75-79 % DMD, good grass silage of 20-25% DM, 14% crude protein and 72-75 % DMD, average grass silage of 20-25 % DM, 11% crude protein and 64-69 % DMD, and to well-managed grazed grass of 11-18 % DM, 16-24 % crude protein and 75-82 % DMD. Additional analyses have not found any elevated levels of plant aluminum, iron or sodium content that would be detrimental to fodder quality.

Other

Biomass

The potential for biomass crops to be grown on the amended residue exists. Several species, *Alnus*, *Betula*, and *Salix* have successfully colonized the restored residue surface. This has been on residue restored for ‘amenity’ land-use. In order to promote high yields of these crops supplemental nutrients and management are required. Due to trial size restrictions on the operating BRDA it has not been possible to pursue this.

Alternative uses of residue

10. AAL needs to remain engaged in the industry evaluation and development of alternative use applications of bauxite residue (this progress should also be shared with the community). This should continue to be funded via AMIRA and other alumina focused research groupings. However, it is recommended that AAL consider:

- 10a. *Funding of regionally focused research for direct, local applications of bauxite residue alternative uses. This would preferably utilise local research institutions and local businesses. If executed correctly this approach can be used as part of the community engagement program and generate value where currently only a liability is evident.*
- 10b. *A market research review of the competing products to potential bauxite residue applications and identify potential commercially viable projects or products. A market driven approach allows the identification of opportunities that research efforts can be directed at rather than researching an application that cannot be applied. The essence is to let the market demand for bauxite residue drive the approach.*
- 10c. *Engaging with EPA to confirm a regulatory pathway for the development of alternative use applications.*
- 10d. *Utilising product development techniques, develop the “Path to Market” and base the economics of the venture on a “profitless” business concept where the “negative” current value of bauxite residue drives a cost recovery approach thereby maximising profit opportunities for downstream businesses and minimising liability for AAL.*
- 10e. *Assessing the potential for application of residue in an un-neutralized form to high volume low value applications. If this is not feasible then application with neutralized residue may be the only means. As bauxite residue is a resource of limited but sustaining value consideration should be given as to how the BRDA could be accessed for recovery of bauxite residue for alternative uses. Re-mining for re-use applications could be considered as a viable means of gradually eliminating the BRDA as a structure if a commercially sustainable re-use of the residue is developed.*

Globally less than 2% of bauxite residue is reused or further processed. The industry is now committed to improving this rate with a target of 20% reuse within the next decade. Aughinish will participate in this industry driven collaboration to explore effective routes for bauxite residue utilization.

High volume applications of bauxite residue within the confines of Ireland will be limiting with land application of modified residue being the most likely option. This has been conducted in other jurisdictions eg. Sardinia where bauxite residue is used for treating acid generating mine wastes. Feasibility of replicating such a practice with the inclusion of regulatory bodies can be explored.

*11. Consider the merits of operating a batch bauxite residue neutralization operation at the BRDA to allow harvesting, treatment and controlled re-use of the current un-neutralized bauxite residue deposit. Should process sand cease to be employed beneficially in the BRDA...adopt the process sand investigation approach of Cooling & Jameson (2004) to define the characteristics needed to develop a sustainable end-use for process sand. These include:*

- Full characterisation of process sand – physical, chemical properties;*
- Assess the need for neutralization of sand – Confirm the presence of bound soda or whether further washing will be sufficient;*
- Conduct parallel tests on sub-grade or filter material – by engaging local civil engineering group/university etc.*
- Confirm the total composition/leachate testing of process sand such that leachate quality is fully understood and accepted by EPA; and*
- Discuss with EPA what aspects they would need to see in process sand such that they could classify it as an inert material.*

At present it is not anticipated that residue sand will be reused or further processed as it is an important component of the amendment procedure of the surface residue for restoration. The amount of residue sand required for closure of the BRDA has increased with the amended zone now increased to 1 m depth (Condition 8.4.21).