



New Zealand Aluminium Smelters Limited

**Interdepartmental  
Committee  
Annual Report  
2012**

*Report to Environment Southland and the Interdepartmental Committee  
on consent monitoring and environmental effects of the  
Tiwai Aluminium Smelter for the year ending 31 December 2012*

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# Summary

## Introduction

This report contains the results of consent monitoring and environmental effects of the New Zealand Aluminium Smelter for the year ending 31 December 2012.

## Main Stack

Main Stack discharges to air were within permit standards during 2012.

## Potline Roof Louvres

Potline roof louvre discharges were within permit standards during 2012.

## Dust Collector Discharges

Twenty one dust collectors were tested during 2012. There were two breaches of the consent limit of 250 mg/Sm<sup>3</sup> and one of these required action to be taken later in the year when retested. Results of the retest exceeded the consent action level of 100 mg/Sm<sup>3</sup>.

## Dispersion

Wind speeds and direction were generally similar to previous years.

Monthly rainfall for 2012 was variable with the annual total of 964 mm being less than usual. The long term annual average is 1104 mm.

## Ambient Air

All sites were within permit standards.

## Atmospheric Deposition

All permit guidelines were met during 2012.

## Vegetation

The fluoride concentrations of ungrazed grass sites were similar to the concentrations measured in 2012.

Fluoride in *Pinus radiata* needles were within permit guidelines during 2012.

The fluoride concentrations of grazed grass for all monitoring farms were within permit standards during 2012 and similar to previous years. Cattle urine on GMF4 during 2012 was within the guideline.

## Water Take

Water take from the aquifer was within permit standards for 2012.

Due to organisational restructuring during December the daily water take is no longer recorded at the weekends or on public holidays. On the first day staff are available the reading is recorded and a calculated average is used for these days.

## **Liquid Discharges**

Discharges from the, South, and West drains and of Treated Effluent and their effect on the environment were within permit standards during 2012.

All permit standards were met for Treated Sewage discharges during 2012.

Groundwater monitoring results from the upstream sewage monitoring bore showed a high result for phosphorous. The phosphorous concentration in the North Bore has shown an increase from an average of 0.07g/m<sup>3</sup> prior to 2011 to greater than 0.2g/m<sup>3</sup> in the last 2 years. The concentrations of nitrogen species has remained stable in this bore indicating it is probably not being affected by the sewage discharge.

The results for south downstream bore are similar to those previously reported.

## **Groundwater**

Groundwater monitoring around the SCL storage shed and underneath the storage shed showed no significant changes of analytes during 2012. The cathode pad stockpile groundwater showed no significant changes of analytes during 2012.

## **Landfill**

Monitoring of groundwater near the NZAS landfill during 2012 showed some variation in the analyte concentrations in the bores but generally analyte levels have stabilised.

## **Greenhouse Gas Discharges**

There was a decrease in absolute carbon dioxide emissions during 2012. The emission rate in 2012 was 1.94 t CO<sub>2</sub>-e / per tonne of aluminium produced.

# **Part A - Environmental Management**

## **Introduction**

This report summarises NZAS' environmental performance during 2012 and includes results, summaries and comments on discharge permit monitoring. It includes data from some reports forwarded to Environment Southland during the year with additional sections including discharges to air, dispersion conditions, liquid discharges etc. to cover NZAS' discharges to, and effects on, the environment.

The data is provided in tables, summaries, maps and where appropriate as graphs. Analysis of trends and other comments are included where appropriate.

The NZAS Laboratory Services team provides much of the data within this report. A comprehensive auditing programme conducted by Environment Southland verifies the validity of this data.

The NZAS system for environmental management is certified as meeting the ISO 14001 requirements. In addition, NZAS' Laboratory has maintained accreditation to NZS/ISO/IEC 17025 "General Competence of Calibration and Testing Laboratories". The scope of the accreditation includes Quality Systems to ensure the accuracy of data. Where samples are forwarded to external laboratories for analysis, these laboratories have accreditation to NZS/ISO/IEC 17025

## **Environmental Improvements**

The worsening financial situation at NZAS over 2012 has curtailed some planned environmental improvement work. Nonetheless, improvements were made where these added significant value to our operational processes or where the improvements could be made with minimal cost. These improvements included:

### **Installation of Real Time Monitoring on Dust Collectors**

Breaches of consent conditions related to dust collector emissions has long been a challenge for NZAS. Without real time monitoring on dust collectors, it is not possible to determine whether an individual dust collector's performance is degrading. By the time emissions are visible to the naked eye, consent conditions will have already been breached. Replacement of dust collector bags is a costly and time consuming business; so early replacement, while minimising the probability of a consent breach incurs significant cost.

In 2012 a real time particulate monitoring system was installed on five dust collectors selected on the basis of historical performance. This system is capable of detecting minor changes in emission performance and can alert operators to problems long before the consent limit is reached. This allows timely maintenance intervention to ensure consent conditions are met whilst minimising costs. This system came online in late 2012 and its performance will be closely monitored over 2013.

## Water Management Contract

After an intensive tendering process NZAS issued a contract to Nalco for the management of all water treatment plant on site. Nalco is a global provider of water treatment solutions and have a substantial track record in delivering optimised water treatment solutions to the aluminium industry. The contract covers the management of all water used on site including that used for casting aluminium, cooling towers and drinking water supplies.

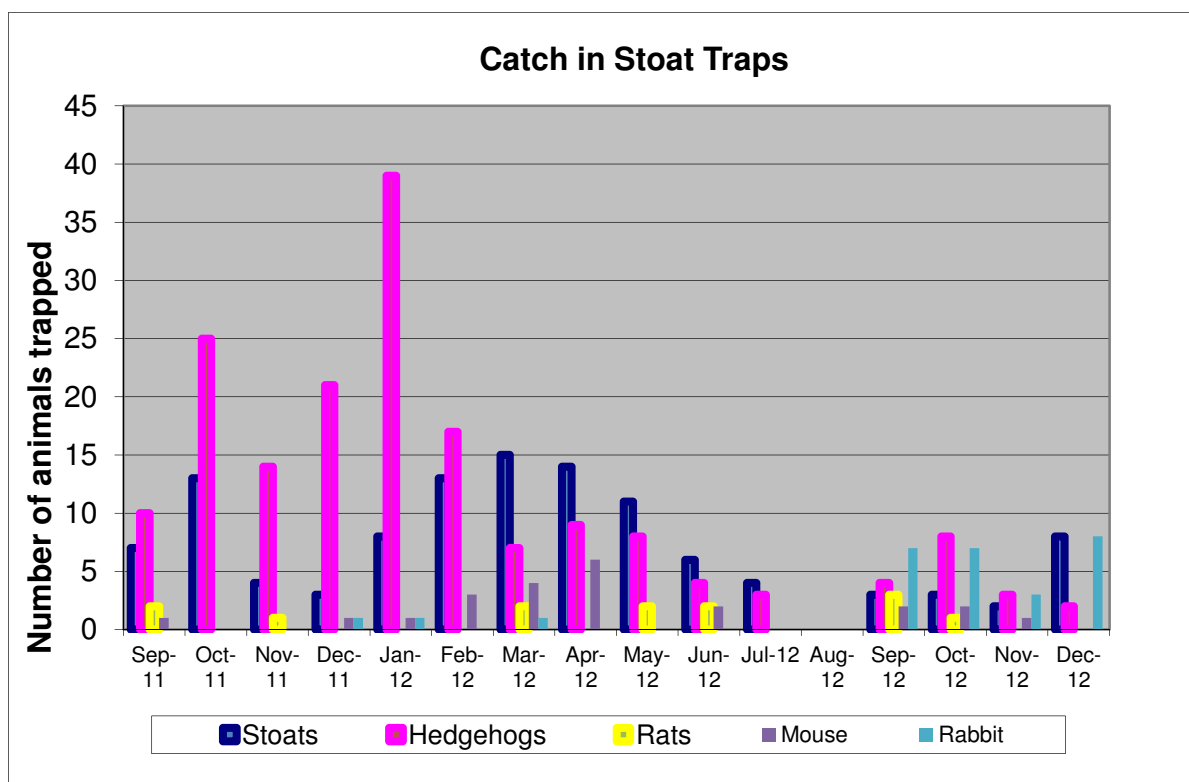
The contract went live in late 2012 and Nalco equipment has been installed on all water treatment units at NZAS. This advanced technology will deliver significant improvements in water quality monitoring in our casting processes and is anticipated to result in a substantial reduction in the amount of chemicals consumed during water treatment. This in turn means that the volumes of chemicals subsequently discharged to sea via our drainage systems will be significantly less than in previous years.

## Peninsula Pest Management

In 2011 Department of Conservation (DOC) assisted NZAS establishing 169 stoat traps to enhance the animal pest control programme on Tiwai Peninsula to further improve biodiversity health and integrity.

Tiwai Peninsula adjoins the Awarua wetlands, an internationally recognised Ramsar site. The adjacent Awarua Bay provides foraging and roosting opportunities for migratory waders and NZ species as southern NZ dotterel, South Island fernbird (endemic to NZ) and the Australasian bittern. The Peninsula supports a variety of threatened plants and rare vegetation communities making it significant regionally, nationally and internationally.

The trapping programme was initially carried out by contractors engaged by NZAS but due to financial difficulties the stoat trapping project is now run with the help of volunteers from NZAS, DOC and the wider community. The catch from the monthly checking of traps is displayed in the graph below.



## Environmental Incidents

### Incidents Involving Consent Violations

There were three environment incidents reported to Environment Southland over 2012.

#### Dust Collector Exceeds Consent Limit – 10 February 2012

As a result of visible emissions from the Alumina Store East Reclaim dust collector, testing was undertaken to determine the emission rate. Results indicated that emissions were 704 mg/Sm<sup>3</sup> compared to the consent limit of 250 mg/Sm<sup>3</sup>. Investigation determined the root cause to be broken bags within the baghouse. These were replaced and the emission rate re-tested at 16 mg/Sm<sup>3</sup>.

This dust collector has now been fitted with real time monitoring equipment as part of the improvement work reported above.

#### Dust Collector Exceeds Consent Limit – 13 August 2012

As a result of visible emissions from the T2 Tower dust collector during alumina delivery, testing was undertaken to determine the emission rate. Results indicated that emissions were 342 mg/Sm<sup>3</sup> compared to the consent limit of 250 mg/Sm<sup>3</sup>. Investigation determined the root cause to be broken bags within the baghouse. These were replaced and the emission rate re-tested at 38 mg/Sm<sup>3</sup>.

This dust collector has now been fitted with real time monitoring equipment as part of the improvement work reported above.

#### HFO Leak to Sea from Ship to Shore Delivery Pipeline – 1 June 2012

On the 1<sup>st</sup> June operators noticed heavy fuel oil (HFO) leaking from the flanges on the delivery pipeline between the ship and the NZAS wharf. Delivery was immediately stopped; however a small amount of HFO had been sprayed over the side of the ship and into the sea. All oil releases to sea from the wharf are treated as consent breaches regardless of the volume involved.

Investigations into the leak determined that an inexperienced operator had installed the wrong gaskets in the joints between sections of the pipeline. Preventative action included expanding the training programme for wharf operators, mandatory review of written procedures before commencing delivery operations and improvements to the storage areas to 'fool proof' the selection of gaskets.



## Audit Programme

Auditing conducted by Environment Southland (ES) during 2012 included:

Audit Sample Type		Sites	Date	Issues
Ambient Air	1km Hut	1	February May	None None
	Bluff	1	November	None
Pine Needles		7	November	None
Atmospheric Deposition		2	February	None
		2	July	None
Drains	North	3	March	Fluoride, conductivity and suspended solids
	South	3	March	Conductivity
	West	3	March	Conductivity
Treated Effluent		1	May	None

## Reports to Environment Southland

### Aquatic Biota Report Status (Coastal Permit 203373)

Condition 11 of NZAS coastal permit 203373 to discharge water containing contaminants to sea requires NZAS to undertake another study into the effects of these discharges on aquatic biota. A range of these studies have been undertaken over the operational life of NZAS with negligible effects being observed. NZAS has continued to reduce the contaminant loading of its discharges with further improvements being undertaken in 2012 as reported elsewhere in this document.

The original deadline of 31 December 2011 was extended to 31 December 2012 in agreement with Environment Southland to allow additional time for determining and costing the scope of the work. After discussions between NZAS, NIWA and Environment Southland, the cost of the work was estimated at \$100,000.

NZAS has subsequently made a submission to Environment Southland to have this consent condition revoked on the grounds that the extensive investigations reported in previous years have found no detectable impact on aquatic biota from NZAS discharges and the cost of undertaking the work is unreasonable given the minimal scientific value that would be obtained. NZAS is awaiting final determination from Environment Southland.

## **Part B - Discharges into Air**

### **Introduction**

Discharges into air from the smelter and wharf were covered by Air Discharge Permit Number 93566 prior to June 2006. A new Air Discharge Permit Number 203378 was issued on the 6<sup>th</sup> June 2006.

This Chapter covers:

- Main Stack discharges,
- Potline Roof Louvre discharges,
- Fluoride discharges into air,
- Dust Collector discharges,
- Main Stack smoke discharges, and
- Sulphur contents of raw materials and fuels used in the aluminium smelting process.

## Main Stack Discharges

### Monitoring results

The following tables show the main stack monitoring results for 2012.

The following shows the running twelve monthly averages of the monthly test results.

Parameter	Units	Running 12 month average	
		Permit Limit	2012
Gas flow rate	Sm <sup>3</sup> / min	-	61,800
Total particulate	kg/min	1.70	0.31
Gaseous fluoride	kg/min	0.50	0.15
Particulate fluoride	kg/min	0.20	<0.01
Sulphur dioxide	kg/min	21.4	11.4
Total condensable hydrocarbons	kg/min	-	NA
Polycyclic aromatic hydrocarbons	kg/min	-	NA

NA: A dispensation was granted by Environment Southland for NZAS to not carry out this monitoring in 2012.

The following table shows the monthly maximum values. Discharges of these contaminants shall not exceed the following maximum values in eleven out of 12 months.

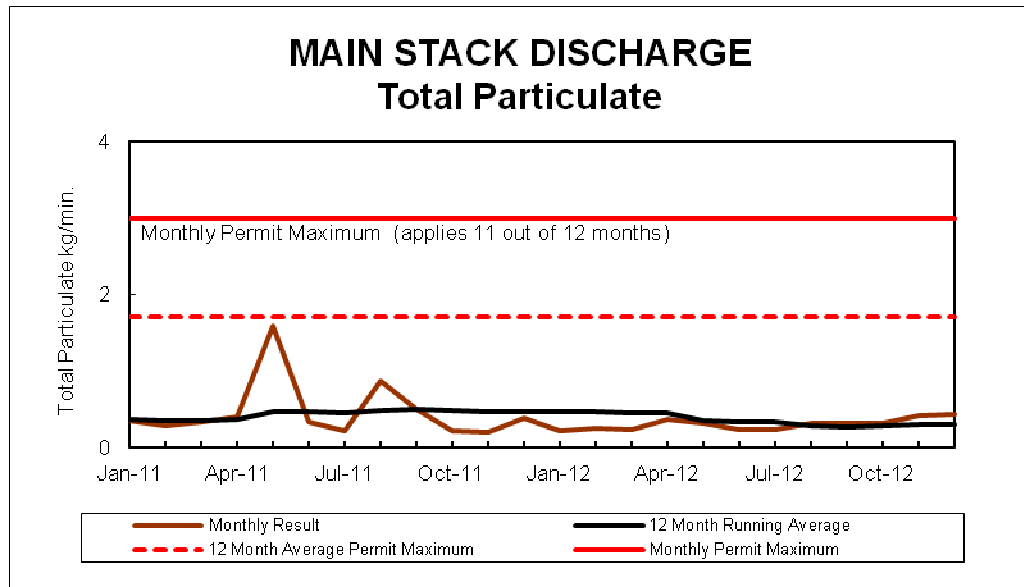
Parameter	Units	Monthly Results		
		Limit applies 11 out of 12 Months		
		Permit Limit	Maximum	Number of times > Limit
Total particulate	kg/min	3.00	0.43	0
Gaseous fluoride	kg/min	0.65	0.27	0
Sulphur dioxide	kg/min	23.0	12.5	0

## Main Stack Discharges, continued

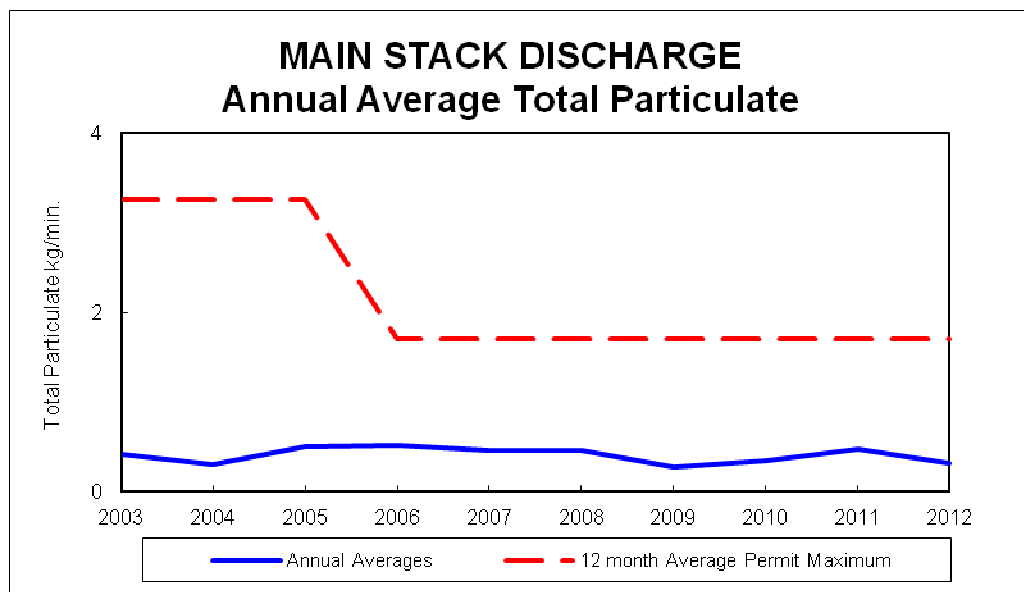
### Total particulate

Permit: 12 month running average not to exceed 1.7 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack total particulate discharge during 2011 and 2012.



The following graph shows the annual average main stack total particulate discharge.

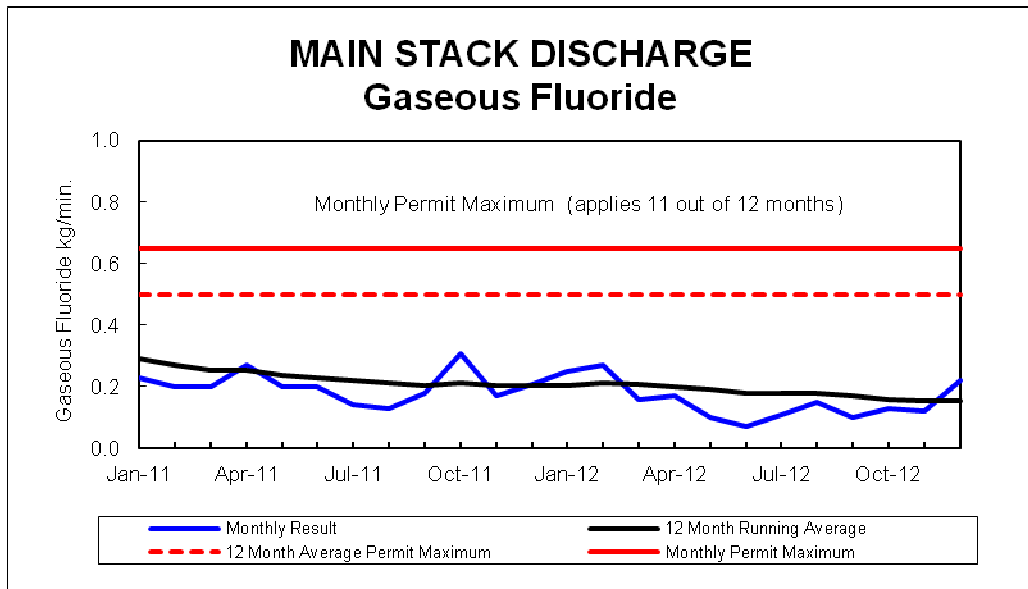


## Main Stack Discharges, continued

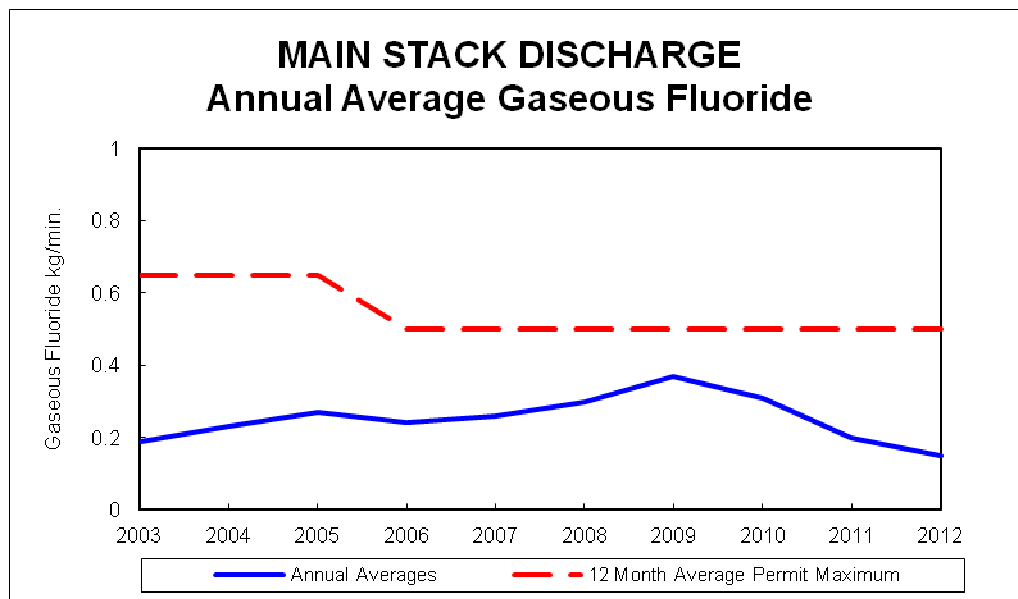
### Gaseous fluoride

Permit: 12 month running average not to exceed 0.5 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack gaseous fluoride discharge during 2011 and 2012.



The following graph shows the annual average main stack gaseous fluoride discharge.

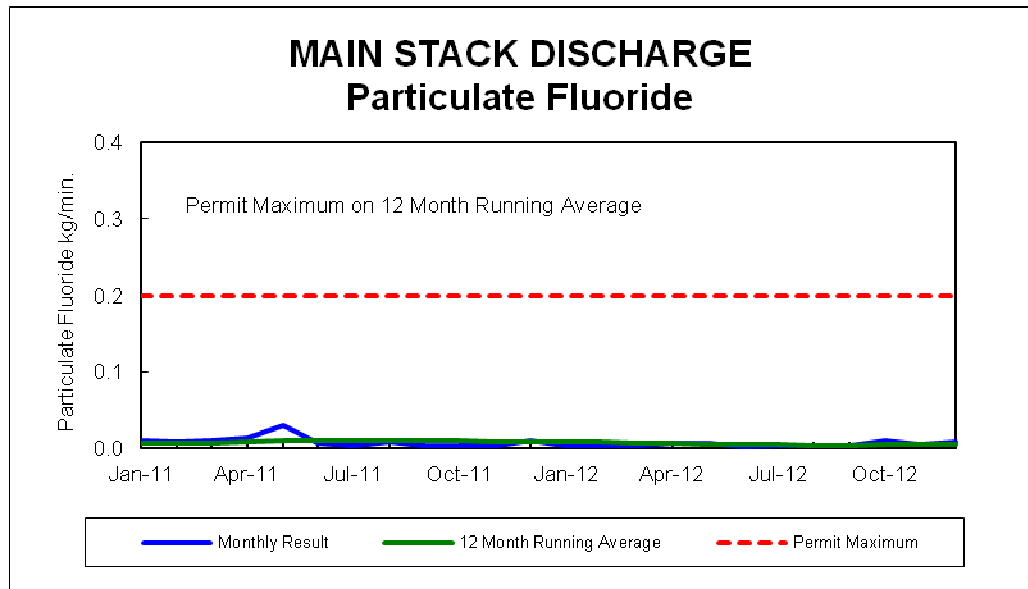


## Main Stack Discharges, continued

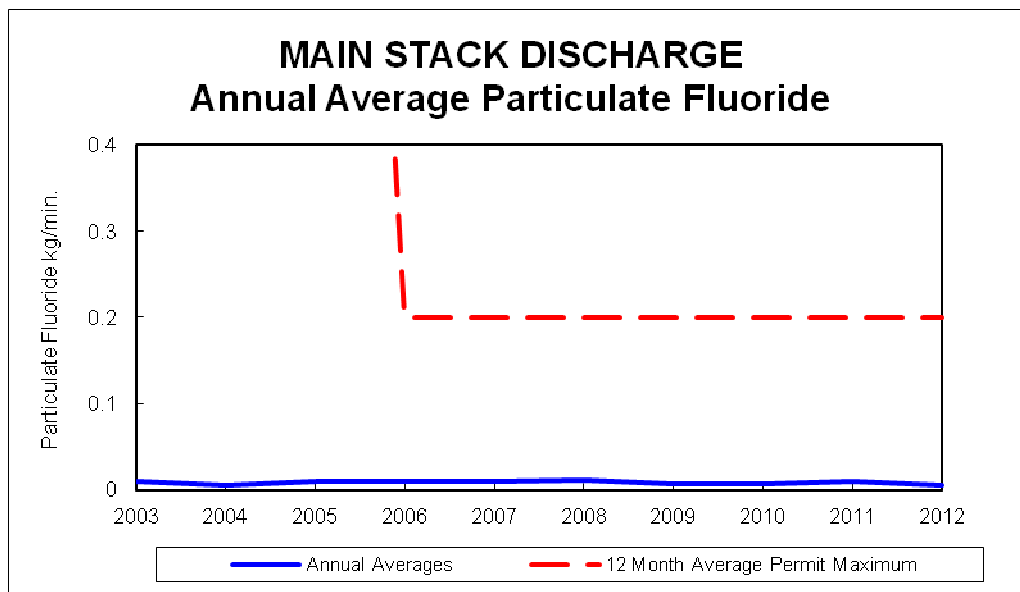
### Particulate fluoride

Permit: 12 month running average not to exceed 0.2 kg/min.

The following graph shows both the average monthly and the 12 monthly running average main stack particulate fluoride discharge during 2011 and 2012.



The following graph shows the annual average main stack particulate fluoride discharge.

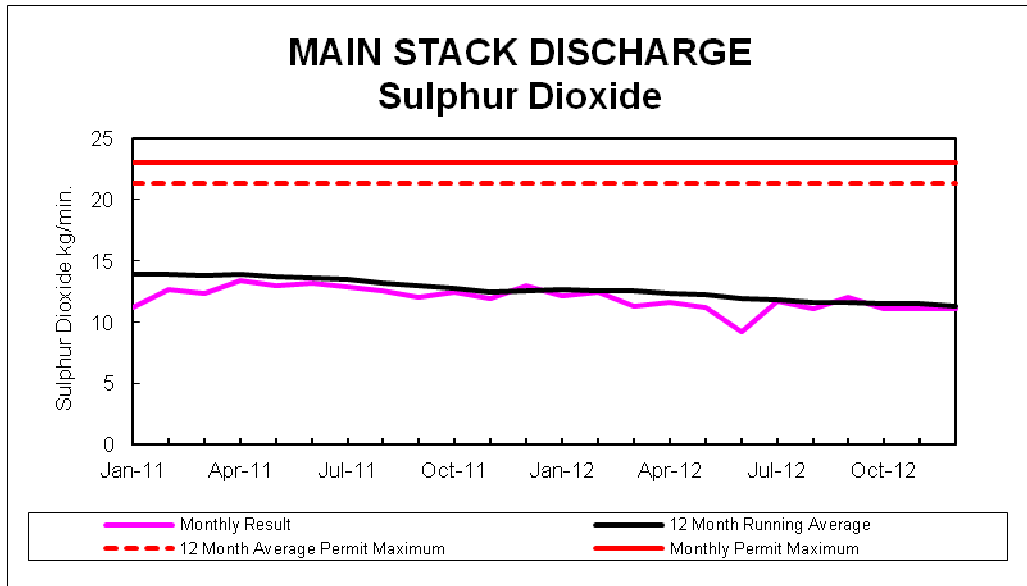


## Main Stack Discharges, continued

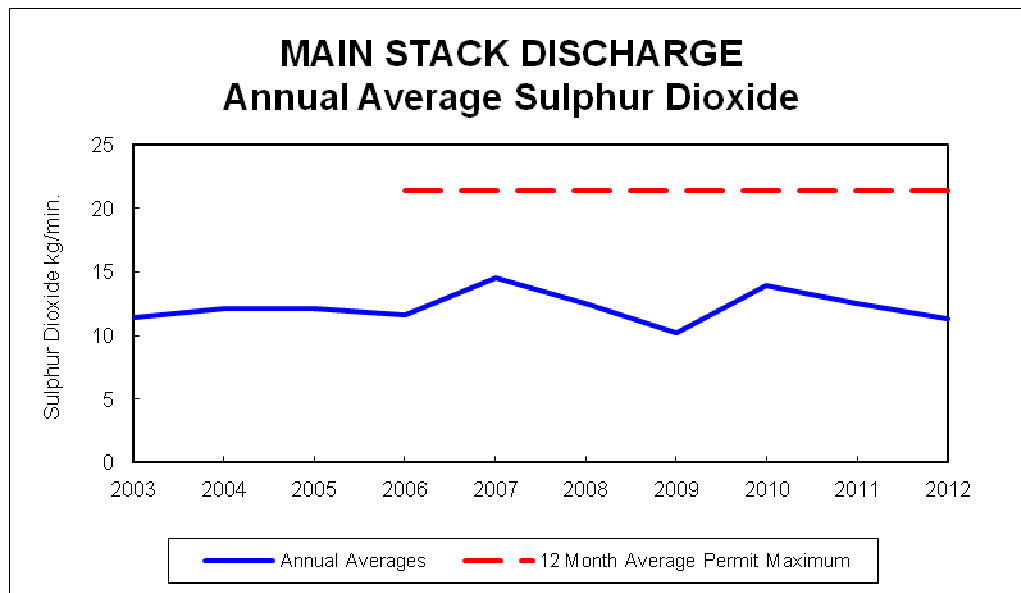
### Sulphur Dioxide

Permit: 12 month running average not to exceed 21.4 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack sulphur dioxide discharge during 2011 and 2012.



The following graph shows the annual average main stack sulphur dioxide discharge.



## **Main Stack Discharges, continued**

### **Total Condensable Hydrocarbons and Polycyclic Aromatic Hydrocarbons**

The annual analysis for total condensable hydrocarbons and 16 USEPA priority PAH was not carried out during 2012 due to the difficult financial situation. A dispensation was granted by Environment Southland for NZAS to not carry out this monitoring in 2012.

## **Comments**

Discharges of total particulate, gaseous fluoride and particulate fluoride from the main stack were within the permit standards throughout 2012.

The reported 12 month running average emissions were lower in 2012 than 2011 due to decreased production and the shutdown of Line 4.



## Potline Roof Louvre Discharges

### Monitoring results

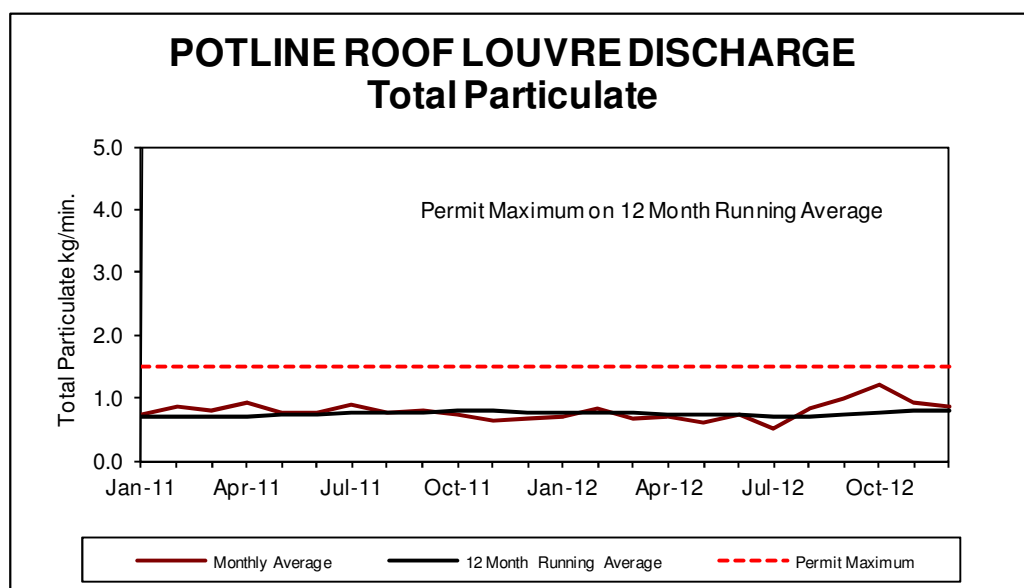
The table below shows the Potline roof louvre monitoring results for 2012. The permit limits are for 12 month running averages. There is no permit limit on maximum emissions in any given month.

Parameter	Units	Running 12 month average		
		Permit Limit	2012	Maximum for any month
Total particulate	kg/min	1.50	0.80	1.20
Gaseous fluoride	kg/min	0.21	0.07	0.09
Particulate fluoride	kg/min	0.30	0.12	0.15
Sulphur dioxide	kg/min	0.55	0.18	0.27

### Total particulate

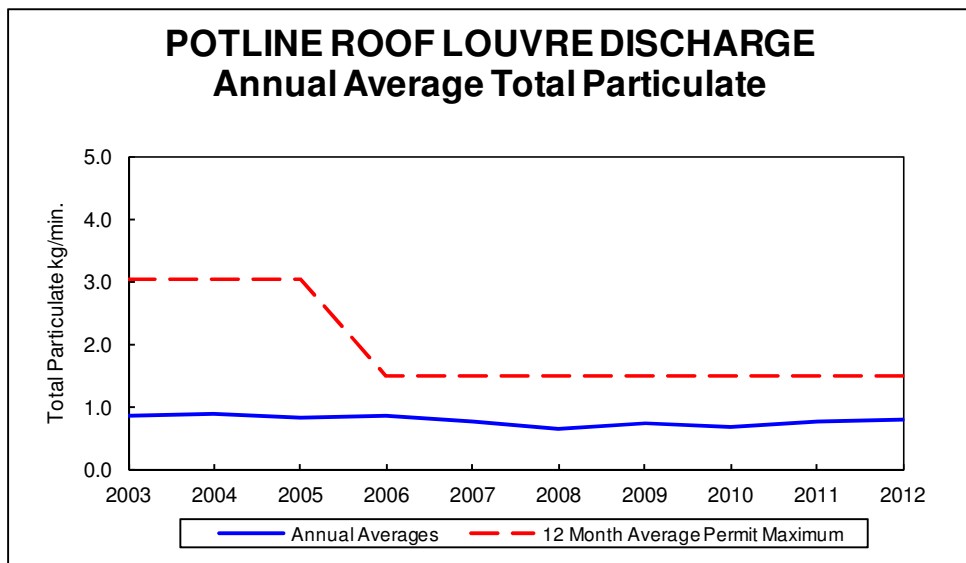
Permit: 12 month running average not to exceed 1.50 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre total particulate discharge during 2011 and 2012.



## Potline Roof Louvre Discharges, continued

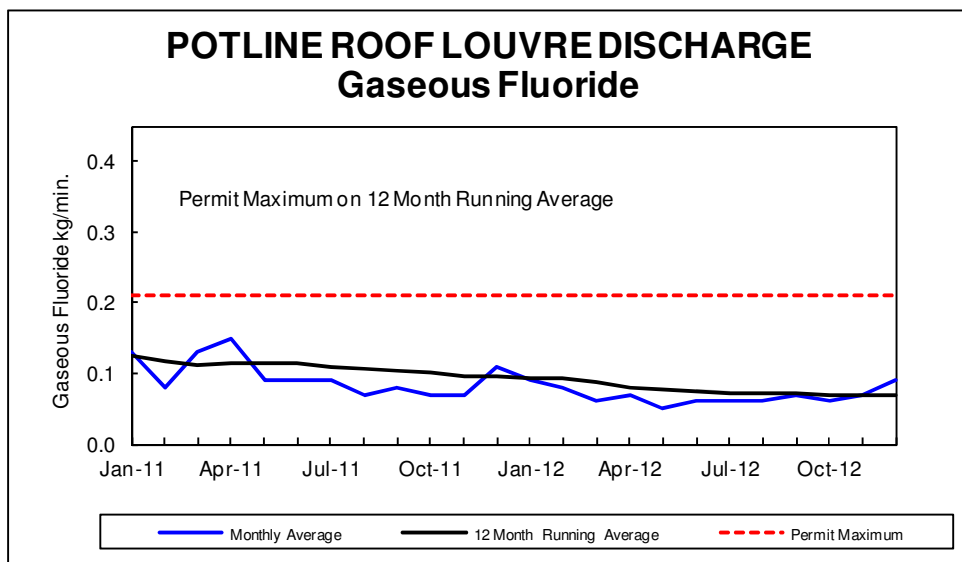
The following graph shows the annual average Potline roof louvre total particulate discharge.



## Gaseous fluoride

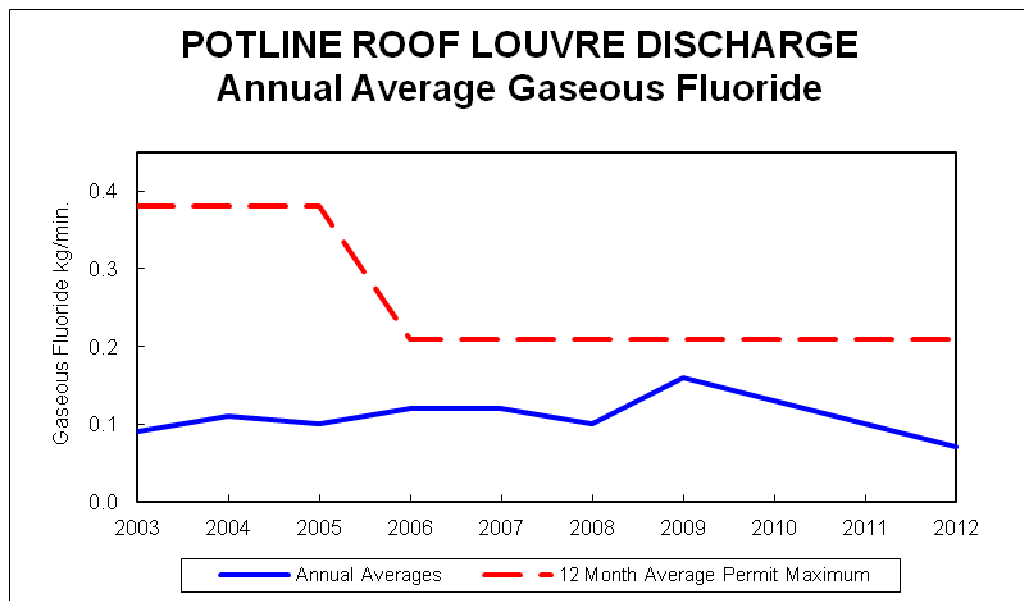
Permit: 12 month running average not to exceed 0.21 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre gaseous fluoride discharge during 2011 and 2012.

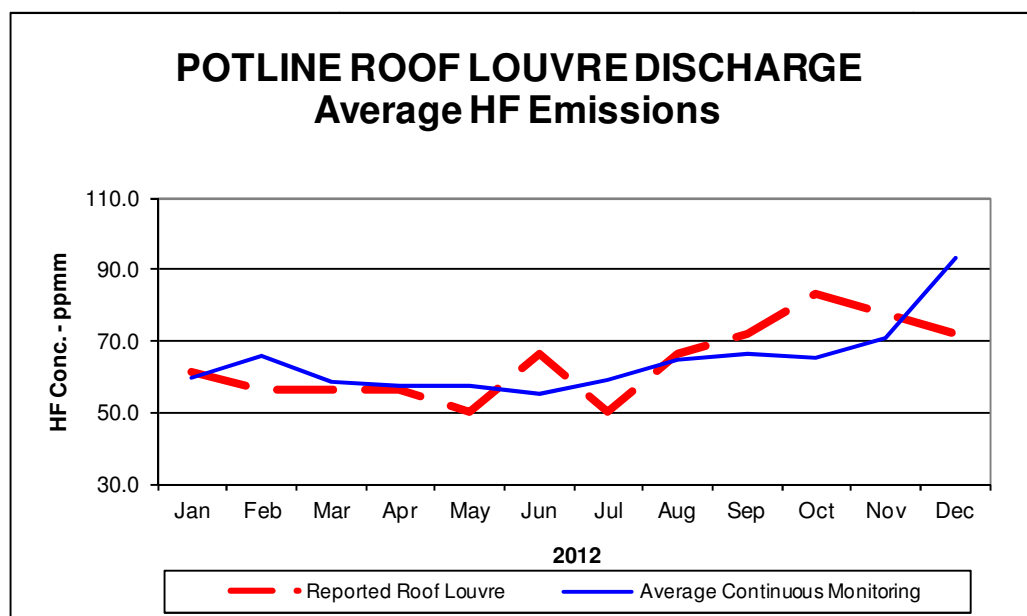


## Potline Roof Louvre Discharges, continued

The following graph shows the annual average Potline roof louvre gaseous fluoride discharge.



The following graph shows the reported Potline Roof Louvre gaseous fluoride emissions in comparison to the Boreal continuous monitoring results.

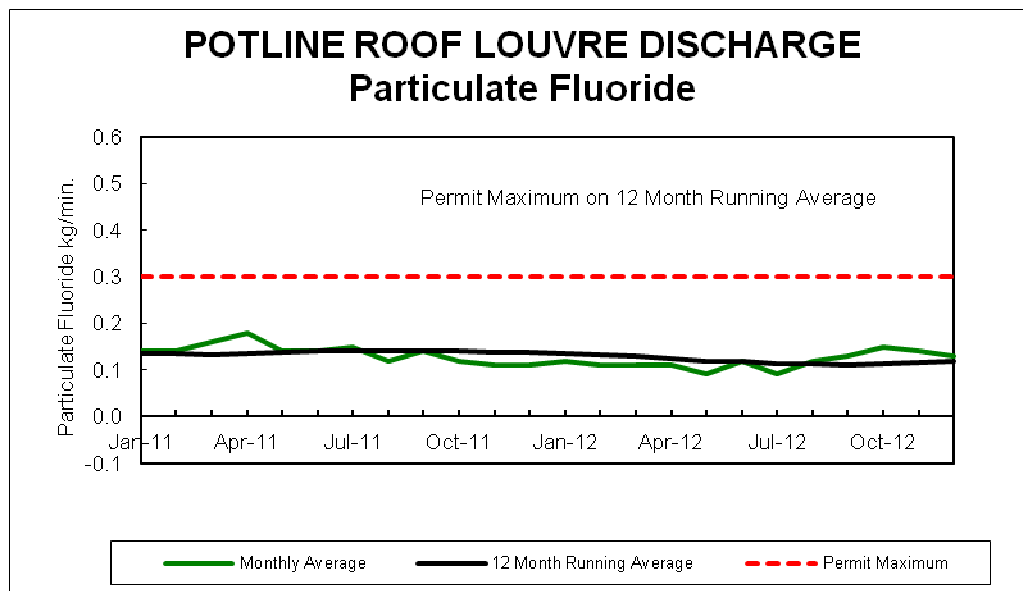


## Potline Roof Louvre Discharges, continued

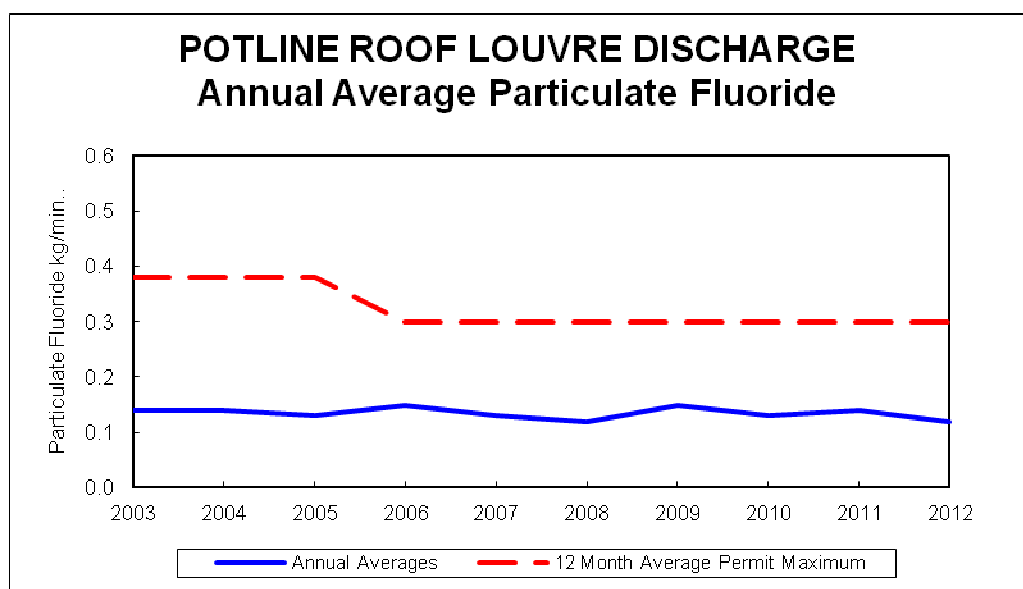
### Particulate fluoride

Permit: 12 month running average not to exceed 0.30 kg/min.

The following graph shows both the average monthly and 12 month running Potline roof louvre particulate fluoride discharge during 2011 and 2012.



The following graph shows the annual average data for Potline roof louvre particulate fluoride discharge.

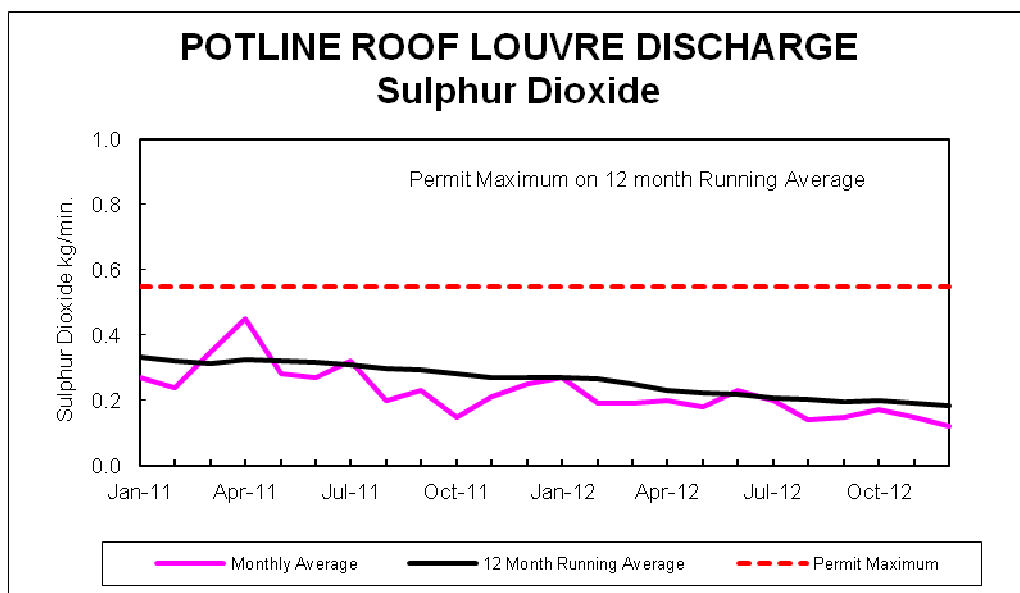


## Potline Roof Louvre Discharges, continued

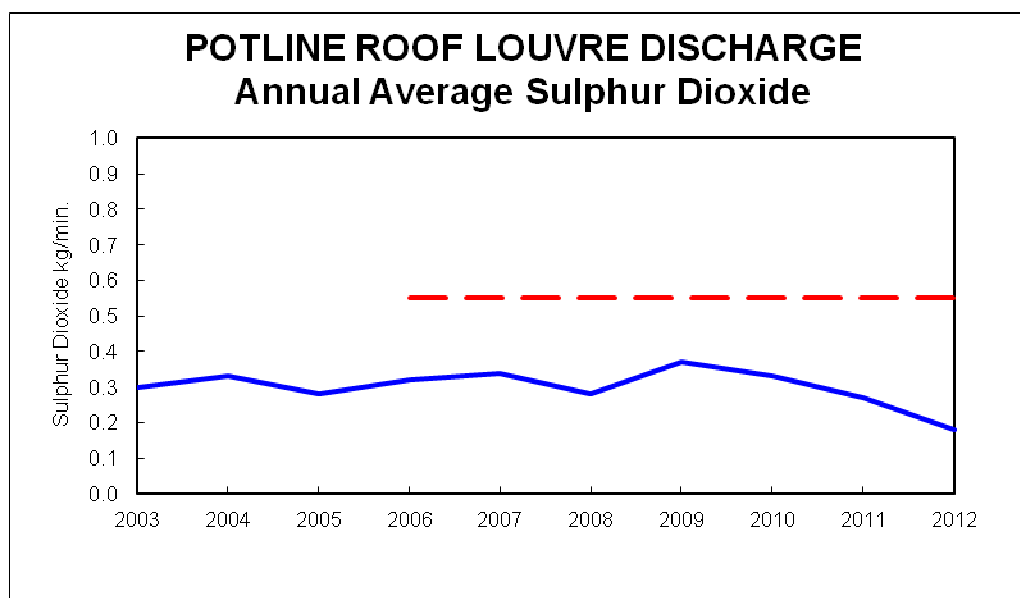
### Sulphur dioxide

Permit: 12 month running average not to exceed 0.55 kg/min.

The following graph shows both the average monthly and 12 month running Potline roof louvre sulphur dioxide discharge during 2011 and 2012.



The following graph shows the annual average Potline roof louvre sulphur dioxide discharge.



## Potline Roof Louvre Discharges, continued

### Comments

The discharge of total particulate, sulphur dioxide, particulate fluoride and gaseous fluoride from the Potline roof louvres were within permit limits. Line 4 was shut down in April 2012 and the Gas Flow Rate for Roof Louvre emissions was adjusted from 656300 Sm<sup>3</sup>/min to 605000 Sm<sup>3</sup>/min.

In July 2012 approval was received from Environment Southland to apply the new analyte correction factors (for total particulate, particulate fluoride, gaseous fluoride and sulphur dioxide) and gas flow rate (785,917 Sm<sup>3</sup>/min) to the emission results for Potline Roof Louvre Discharges from August 2012. The gas flow rate and correction factors have been adjusted to take into account the shutdown of Line 4. The adjusted gas flow rate has reduced from 785,917 Sm<sup>3</sup>/min to 720,800 Sm<sup>3</sup>/min.

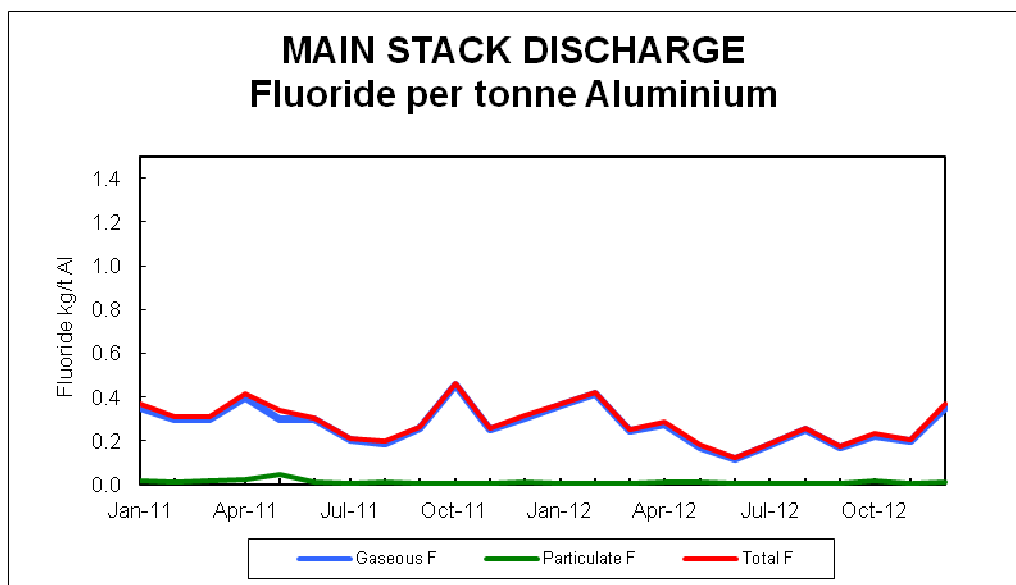
## Fluoride Discharges

### Performance data

The table below shows the fluoride discharges expressed as a ratio of hot aluminium metal production during 2012.

Parameter	Units	2012	Maximum for any month
Main Stack			
• Gaseous fluoride	kg/t Al	0.25	0.42
• Particulate fluoride	kg/t Al	0.01	0.02
• Total fluoride	kg/t Al	0.26	0.42
Reduction Line Roof Louvres			
• Gaseous fluoride	kg/t Al	0.11	0.14
• Particulate fluoride	kg/t Al	0.19	0.25
• Total fluoride	kg/t Al	0.30	0.35
Plant			
• Gaseous fluoride	kg/t Al	0.36	0.54
• Particulate fluoride	kg/t Al	0.20	0.27
• Total fluoride	kg/t Al	0.56	0.72

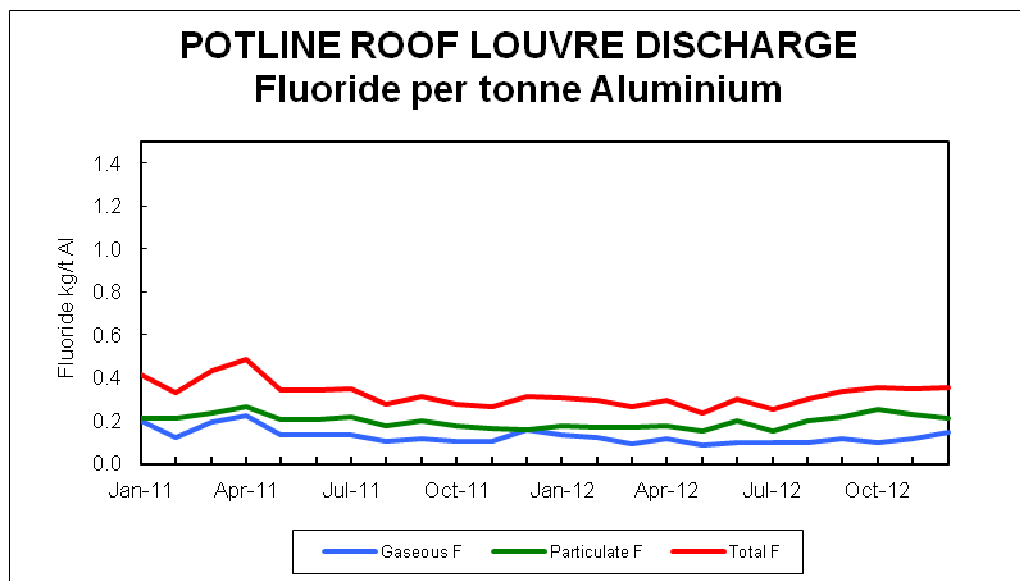
The following graph shows the monthly main stack fluoride per tonne aluminium discharge during 2011 and 2012.



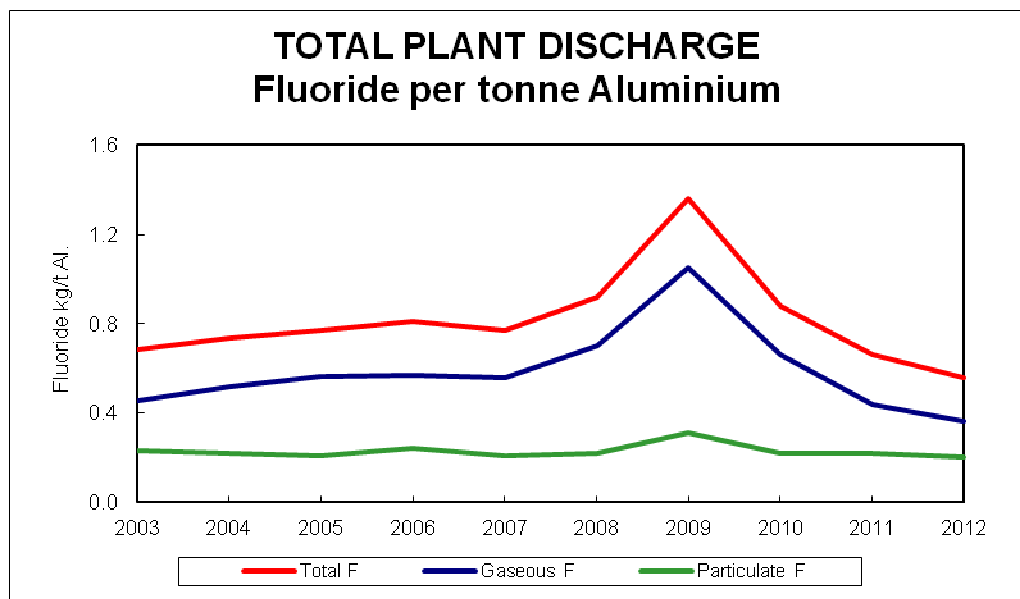
## Fluoride Discharges, continued

### Performance data, Continued

The following graph shows the average monthly Potline roof louvre fluoride per tonne aluminium discharge during 2011 and 2012.



The following graph shows the average total plant fluoride per tonne aluminium for the last 10 years.



### Comments

The annual total fluoride discharge rate from the plant has decreased during 2012.



## Dust Collector Discharges

### Permit Conditions:

Shall not exceed	250	mg/Sm <sup>3</sup>
Action shall be taken if concentration exceeds	100	mg/Sm <sup>3</sup> .

### Monitoring results

The table below shows the Dust Collector monitoring results for 2012. The table reflects the new Air Discharge Permit standards, which came into effect in June 2006. The Permit requires that all dust collectors be tested once every two years.

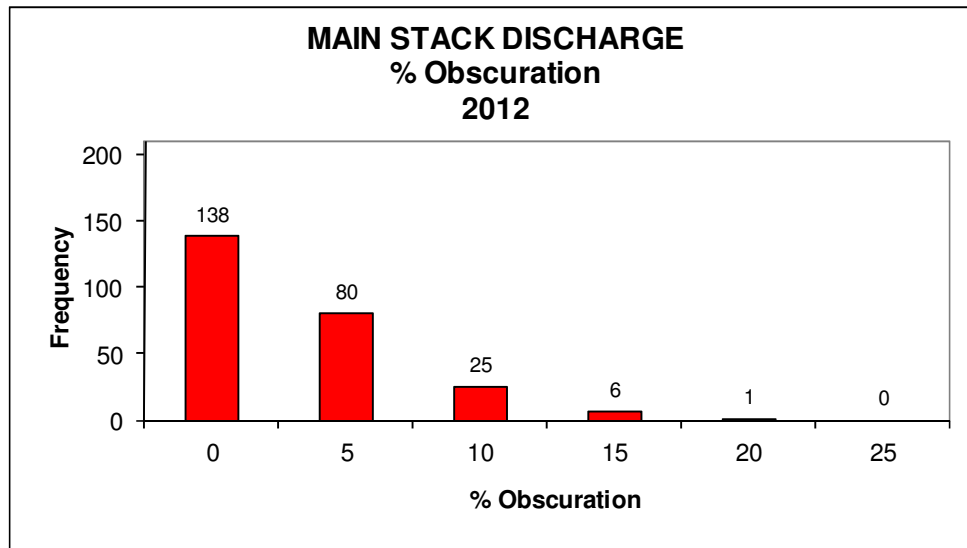
Dust Collector	Date	Total particulate discharge mg/Sm <sup>3</sup>
T1	January	33,8
Centre Reclaim	January	3,2
Crucible Cleaner	January	34,36
East W Reclaim	February	704,791,15
Bath Crusher	January	1
SCL Shed	February	3
L4 Bathbin	March	10
MRP	April	21,28
Mill Top	July	3,6
East W Reclaim	August	226,4
Nuisance	July	33,2
Ball Mill	July	21,22
T2	August	342,38
Coke Store	August	3
East E Reclaim	October	15
Day Bin 1	October	2,1
Sicon 1	October	23,1
Daybin 2	November	1,0
Sicon 2	November	2,1
Daybin 3	November	1,1
Sicon 3	November	2,1

### Comments

Two dust collectors exceeded the consent level of 250 mg/Sm<sup>3</sup> with both, the East W Reclaim, and the T2 back to normal operational levels within a few days. The East W Reclaim was retested later in the year and again found to be above the action level of 100 mg/Sm<sup>3</sup>, but back to normal operation levels within a few days.

## Main Stack Smoke Discharges

Main Stack smoke discharges were determined by visual observations using the standard Ringleman chart. The following graph summarises the observations recorded during 2012.



During 2012 there was a decrease in the frequency of observations in the 1 to 5% range and no observations greater than 20%. The majority of the observations were 0%.

## Sulphur Content of Raw Materials and Fuels

The following table shows the maximum, minimum, and average sulphur content of raw materials and fuels delivered to the smelter during 2012.

Material	Units	Permit Maximum	2012 Annual Average	2012 Maximum	2012 Minimum
Petroleum Coke	%	4	2.85	3.30	2.22
Pitch	%	1	0.49	0.60	0.42
Heavy Fuel Oil	%	3.5	2.14	2.59	1.91

### Comments

All shipments of raw materials and fuels during the 2012 met the permit standards for sulphur content.

During 2012 the average sulphur content of the Petroleum Coke increased from 2.78 to 2.85%, while shipments of Heavy fuel oil have been decreased in sulphur content. Pitch also showed a slight increase (0.02%) in sulphur levels.

## Part C - Dispersion Conditions

### Introduction

This chapter covers the monitoring of meteorological conditions at the Tiwai Point meteorological station. These conditions effect the dispersion of discharges into air from the smelter. The data includes:

- the distribution of wind strength,
- the distribution of wind direction, and
- rainfall.

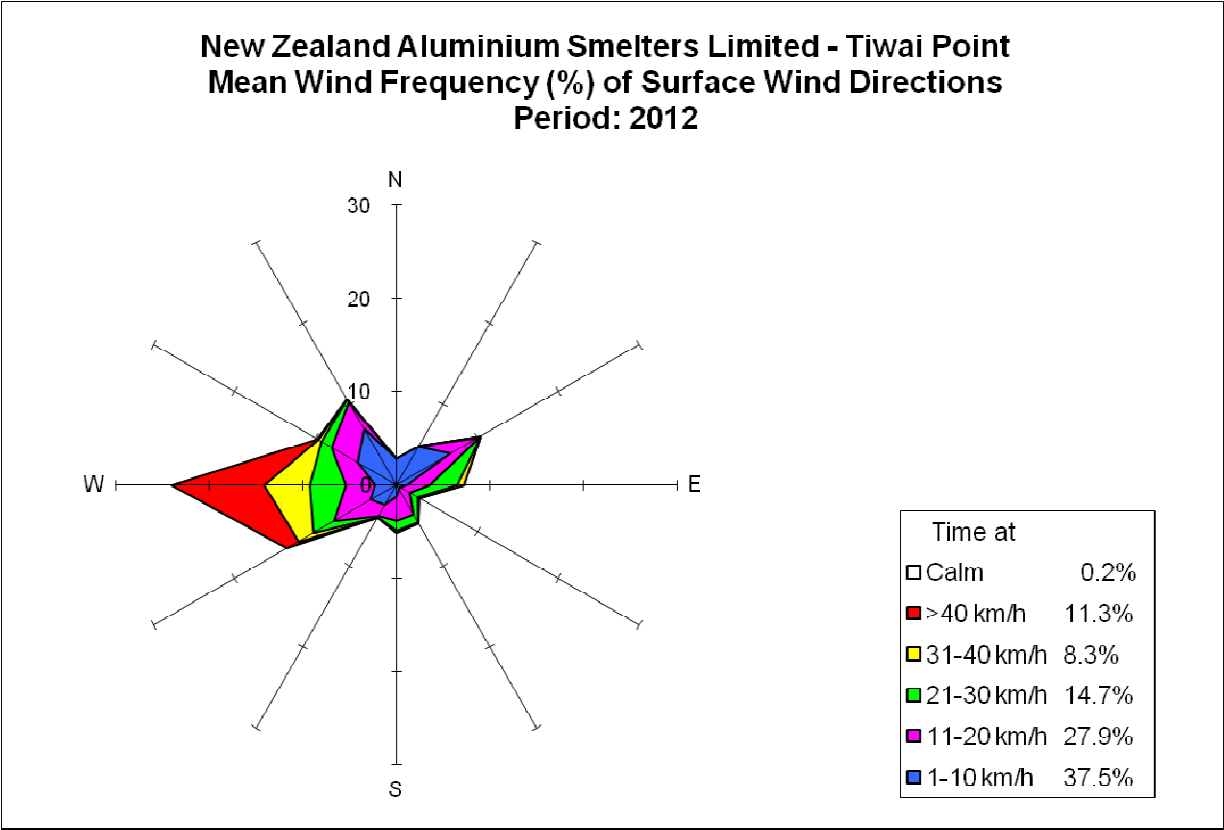
### Meteorological Conditions

The mean wind frequency diagram on the following page shows that the 2012 wind pattern was dominated by westerly, north-westerly and north-easterly winds. Dispersion conditions are similar to previous years.

The following table shows the predominant winds and total rainfall recorded for each month during 2012.

Month	Predominant Wind Direction	Rainfall (mm)
January	West	98
February	Southeast northeast and southwest	56
March	West, northeast and northwest	100
April	West and northwest	42
May	West, northeast and northwest	78
June	Southwest, west and northwest	113
July	Northwest and northeast	20
August	East, northwest and northeast	21
September	West, northeast and northwest	122
October	West and east	141
November	West	66
December	West	107

Total rainfall for the year is 964 mm. The five year average is 1017mm. The long term average is 1107mm of rainfall.



## Part D - Ambient Air

### Introduction

This chapter covers the monitoring for gaseous and particulate fluorides in ambient air at five monitoring sites. At all sites, except the 1km Hut site, sampling is by a method based on a sampling period of up to one-month. The 1km Hut site is located on Rio Tinto Alcan freehold land and is sampled on a weekly basis.

### Permit Limits

The limits for ambient air gaseous fluoride covered by the air discharge permit are:

- 24 hour average  $2.0 \mu\text{g}/\text{m}^3$
- 7 day average  $1.0 \mu\text{g}/\text{m}^3$
- One month average  $0.5 \mu\text{g}/\text{m}^3$

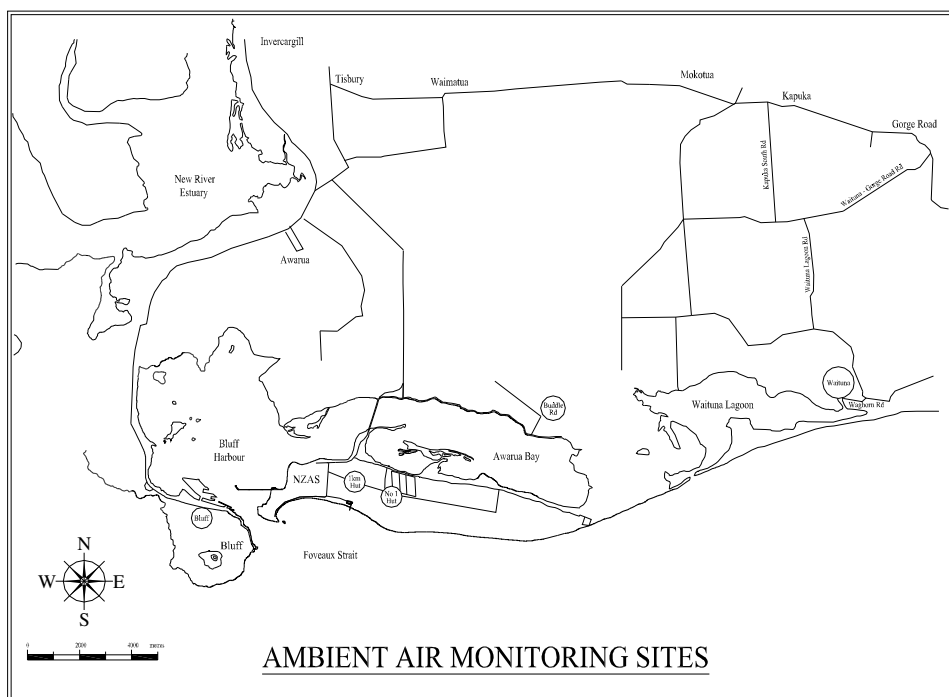
The limits apply to measurements on land other than Tiwai Peninsula and on Tiwai Peninsula east of Rio Tinto Alcan freehold land.

At sites other than the 1km Hut, if two consecutive monthly results exceed 0.3 micrograms per cubic metre gaseous fluoride, then the monitoring shall revert to a seven-day sampling period. Sampling on a longer time basis may be resumed when two consecutive seven-day results are each less than 0.3 micrograms per cubic metre.

The sampling and analysis method used is referenced to AS 3580.1991 and has a detection limit of  $0.1 \mu\text{g}/\text{m}^3$ .

### Site Locations

The locations of the monitoring sites are shown in following map.



## Ambient Air at 1 Kilometre Hut

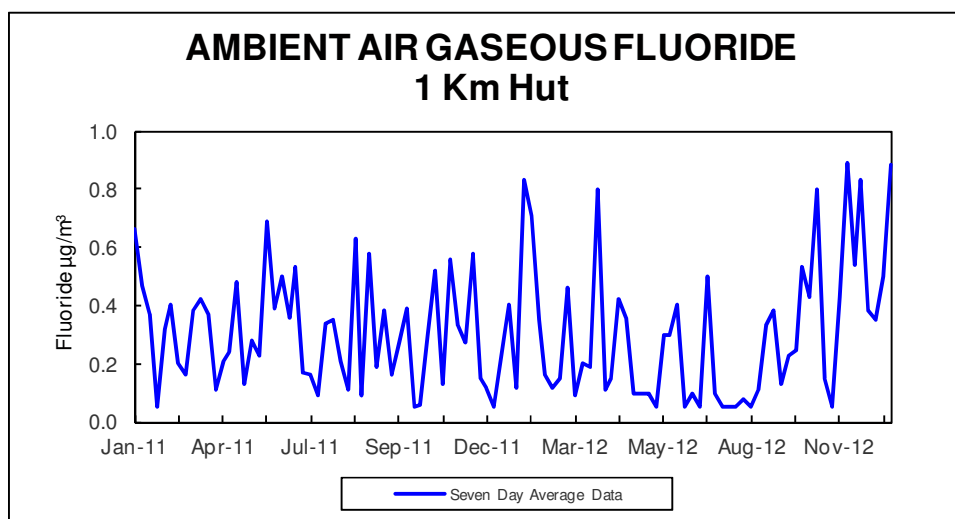
### Monitoring results

The following table summarises the monitoring results during 2011 and 2012. The sampling frequency for ambient air fluoride at this site is seven days.

Parameter	Units	2011	2012
Gaseous Fluoride Concentration			
• Max 7 day average	$\mu\text{g}/\text{m}^3$	0.70	0.90
• Max monthly average	$\mu\text{g}/\text{m}^3$	0.40	0.50
• Annual average	$\mu\text{g}/\text{m}^3$	0.30	0.29
Particulate fluoride concentration			
• Max 7 day average	$\mu\text{g}/\text{m}^3$	0.50	0.60
• Max monthly average	$\mu\text{g}/\text{m}^3$	0.20	0.30
• Annual average	$\mu\text{g}/\text{m}^3$	0.10	0.11

### Gaseous fluoride

The following graph shows the seven-day average gaseous fluoride results for this site.

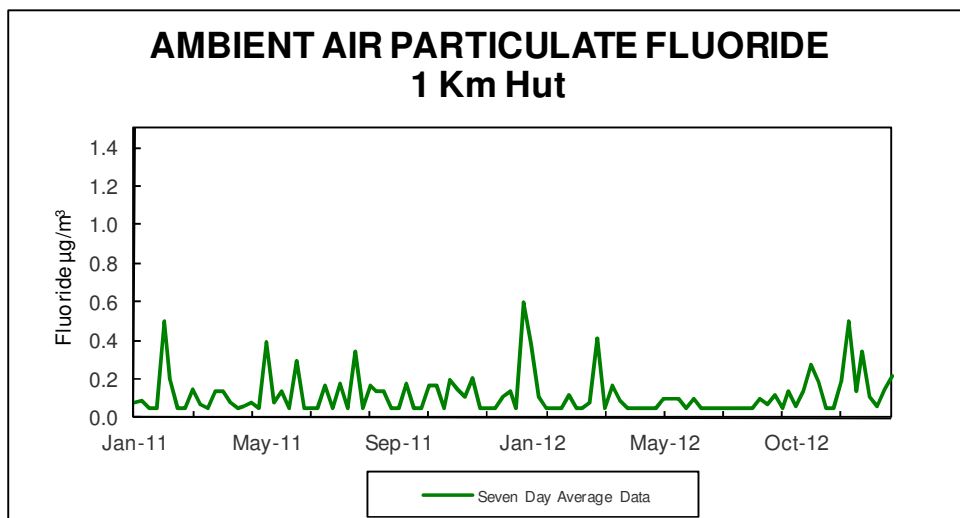


Note: Concentrations less than  $0.1 \mu\text{g}/\text{m}^3$  are plotted as  $0.05 \mu\text{g}/\text{m}^3$

## Ambient Air at 1 Kilometre Hut, continued

### Particulate Fluoride

The following graph shows the seven-day average particulate fluoride results for this site.



Note: Concentrations less than  $0.1 \mu\text{g}/\text{m}^3$  are plotted as  $0.05 \mu\text{g}/\text{m}^3$

### Comments

The gaseous and particulate fluoride levels are similar to those reported in 2011.



## Ambient Air at No. 1 Bore on Tiwai Peninsula

### Monitoring results

The following table summarises the monitoring results during 2011 and 2012 for the No. 1 Bore site located on Tiwai Peninsula.

Site	Parameter	Units	Limit	2011	2012
No. 1 Bore	Gaseous Fluoride				
	• Max 7 day average	$\mu\text{g}/\text{m}^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu\text{g}/\text{m}^3$	0.5	0.20	0.10
	• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	Particulate Fluoride				
	• Max 7 day average	$\mu\text{g}/\text{m}^3$		N.D.	N.D.
	• Max monthly average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1

N.D: Not Determined.

### Comments

Gaseous and particulate fluoride concentrations were within the permit standards throughout 2012.

## Ambient Air at Sites off Tiwai Peninsula

### Monitoring results

The following table summarises the monitoring results during 2011 and 2012 for the three ambient air-monitoring sites located off Tiwai Peninsula.

Site	Parameter	Units	Limit	2011	2012
Buddle Road	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu\text{g}/\text{m}^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu\text{g}/\text{m}^3$	0.5	< 0.1	< 0.1
	• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	Particulate Fluoride concentration				
	• Max 7 day average	$\mu\text{g}/\text{m}^3$		N.D.	N.D.
Waituna	• Max monthly average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu\text{g}/\text{m}^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu\text{g}/\text{m}^3$	0.5	< 0.1	< 0.1
	• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
Bluff	Particulate Fluoride concentration				
	• Max 7 day average	$\mu\text{g}/\text{m}^3$		N.D.	N.D.
	• Max monthly average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu\text{g}/\text{m}^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu\text{g}/\text{m}^3$	0.5	< 0.1	< 0.1
	• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	Particulate fluoride concentration				
	• Max 7 day average	$\mu\text{g}/\text{m}^3$		N.D.	N.D.
	• Max monthly average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1
	• Annual average	$\mu\text{g}/\text{m}^3$		< 0.1	< 0.1

N.D: Not Determined.

### Comments

Gaseous and particulate fluoride concentrations were below the detection limit of the Australian Standard (AS 3580.1991) method at these sites and thus within the permit standards throughout 2012.

## Part E - Atmospheric Deposition

### Introduction

This chapter covers the monitoring of atmospheric deposition at seven monitoring sites.

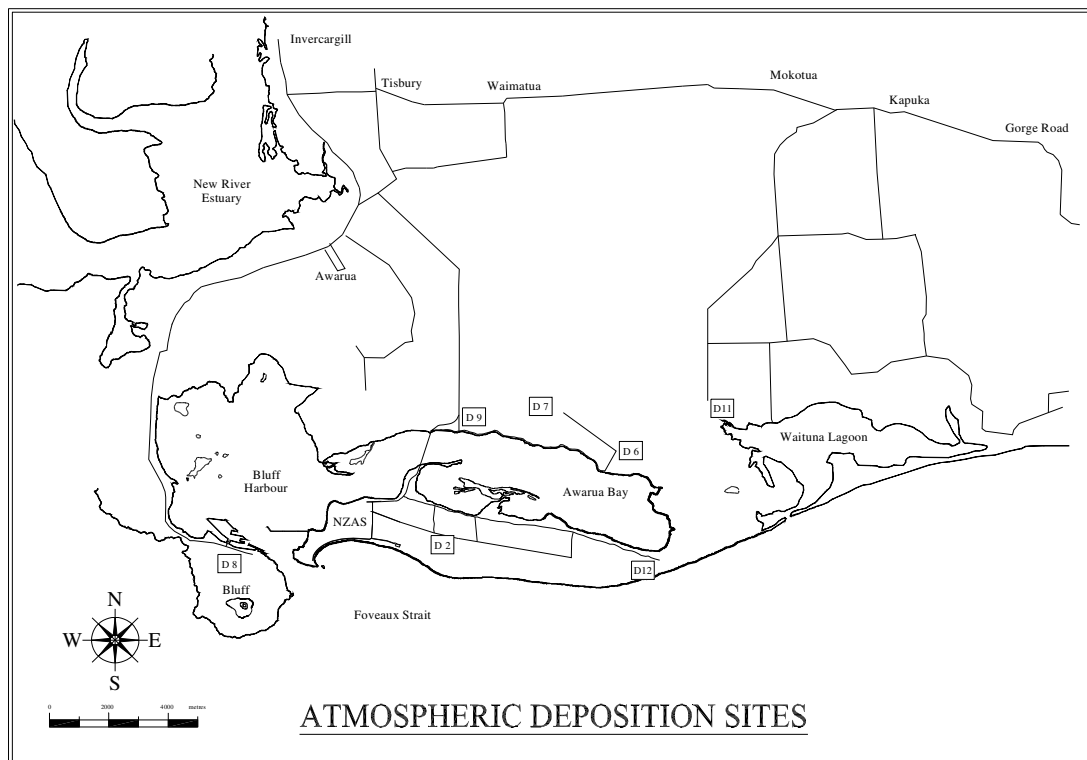
### Permit Guidelines

The guidelines for atmospheric deposition apply to sites off Tiwai Peninsula and are shown in the table below.

Parameter	Unit	Guideline
Fluoride:	$\text{g.m}^{-3}$	0.9

### Site Locations

The locations of the monitoring sites are shown in the following map.



## Atmospheric Deposition Monitoring Results

### Fluoride Deposition

The fluoride atmospheric deposition during 2012 is summarised in the following table.

Site	Units	2012 Average	Maximum for any month	Minimum for any month
D2. No.1 Bore <sup>1</sup>	g.m <sup>-3</sup>	0.29	1.40	0.10
D12 TEF2 <sup>1</sup>	g.m <sup>-3</sup>	0.25	2.60	<0.05
D6 Buddle Road	g.m <sup>-3</sup>	0.08	0.34	<0.05
D7 Gibson's Farm	g.m <sup>-3</sup>	0.07	0.24	<0.05
D8 Bluff	g.m <sup>-3</sup>	0.06	0.23	<0.05
D9 Awarua Bay Road	g.m <sup>-3</sup>	0.06	0.16	<0.05
D11 Marshall Road	g.m <sup>-3</sup>	<0.05	0.24	<0.05

<sup>1</sup> Site located on Tiwai Peninsula and excluded from permit guideline.

### Comments

All permit guidelines were met during 2012. Fluoride deposition during 2012 was within the normal range of results since the commissioning of the main stack dry scrubbing system in 1996.

Note 1: Sites D2 (No 1 Bore) and D12 (TEF2) which are not covered by the permit guidelines also were both within the limits for fluoride.

## Part F - Fluoride in Ungrazed Grass

### Introduction

This chapter covers the monitoring of fluoride in ungrazed grasses at 24 monitoring sites located at Bluff, Green Hills, Awarua Plains, Waituna Wetlands and Tiwai Peninsula.

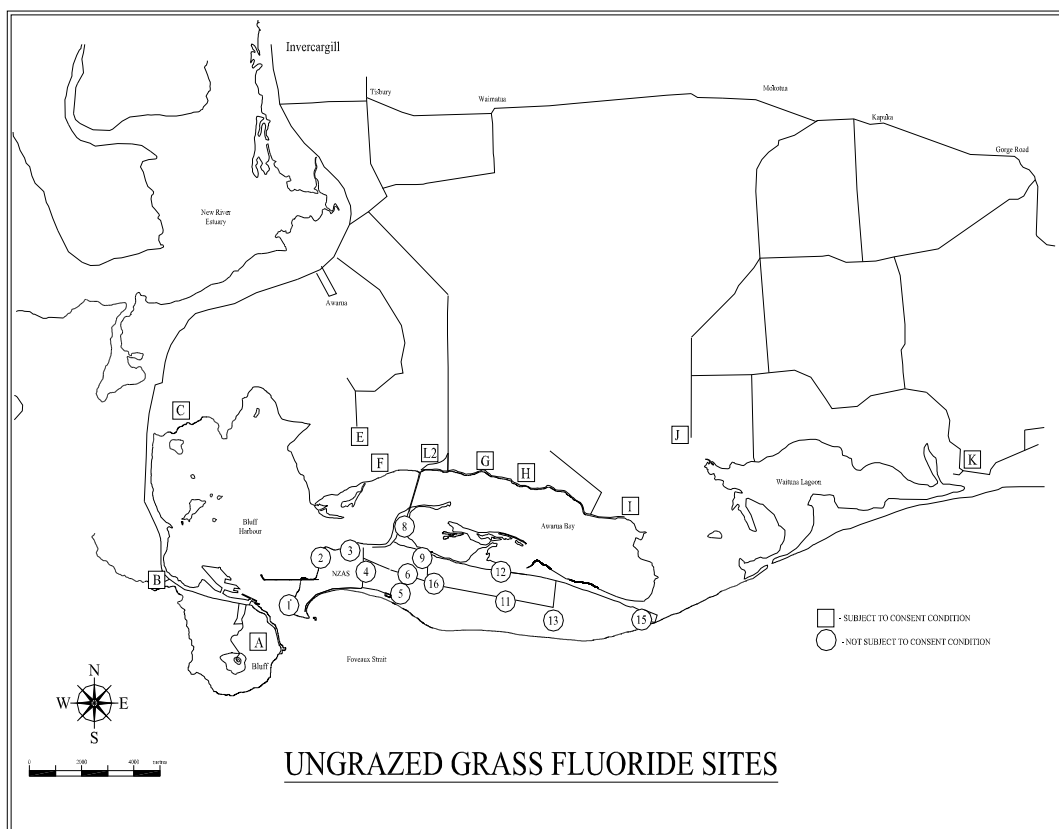
### Permit Guidelines

The guidelines for fluoride in ungrazed grasses (on an unwashed, dry weight basis) on land off Tiwai Peninsula are detailed below. These guidelines came into effect in April 1994.

- Monthly sample shall not exceed 80 mg/kg more than once in any 12 consecutive months.
- Running average of any two consecutive months shall not exceed 60 mg/kg.
- Running average of any 12 consecutive months shall not exceed 40 mg/kg.

### Site Locations

The ungrazed grass monitoring sites are shown on the following map.



## Ungrazed Grass Monitoring Results

### Annual average fluoride concentrations

The following table summarises monitoring results of ungrazed vegetation sites for 2011 and 2012. The permit guideline only applies to land other than Tiwai Peninsular (sites A to L2).

Site	Permit Guideline mg/kg	2011 Average mg/kg	2012 Average mg/kg
1	NA	5	8
2	NA	63	64
3	NA	123	40
4	NA	597	639
5	NA	19	17
6	NA	93	73
8	NA	10	10
9	NA	24	26
11	NA	8	8
12	NA	5	11
13	NA	7	5
15	NA	6	3
16	NA	26	19
A	40	5	5
B	40	4	4
C	40	10	15
E	40	4	3
F	40	5	5
G	40	5	6
H	40	8	9
I	40	5	6
J	40	5	3
K	40	3	3
L2	40	5	5

NA – Guideline not applicable.

## Ungrazed Grass Monitoring Results, continued

### Monthly maximum concentration

The following table shows the maximum monthly fluoride concentrations for sites off Tiwai Peninsula during 2012.

<b>Sites off Tiwai Peninsula</b>	<b>Permit Guideline not to be exceeded more than once in any 12 month consecutive months. mgF/kg</b>	<b>Maximum Monthly Result During 2012 mgF/kg</b>
Ungrazed Grass Site A	80	11
Ungrazed Grass Site B	80	10
Ungrazed Grass Site C	80	37
Ungrazed Grass Site E	80	10
Ungrazed Grass Site F	80	12
Ungrazed Grass Site G	80	13
Ungrazed Grass Site H	80	23
Ungrazed Grass Site I	80	12
Ungrazed Grass Site J	80	7
Ungrazed Grass Site K	80	6
Ungrazed Grass Site L2	80	13

The monthly fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2012. Site C continues to show elevated concentrations from time to time. This issue has been discussed with Environment Southland on previous occasions and is attributed to non NZAS activities around that location.

## Ungrazed Grass Monitoring Results, continued

### Two month average concentration

The following table shows the maximum two-month running average fluoride concentrations for sites off Tiwai Peninsula during 2012.

<b>Sites off Tiwai Penninsula</b>	<b>Permit Guideline</b>  <b>mgF/kg</b>	<b>Maximum Two Month Running Average During 2012</b>  <b>mgF/kg</b>
Ungrazed Grass Site A	60	8
Ungrazed Grass Site B	60	8
Ungrazed Grass Site C	60	28
Ungrazed Grass Site E	60	7
Ungrazed Grass Site F	60	9
Ungrazed Grass Site G	60	11
Ungrazed Grass Site H	60	22
Ungrazed Grass Site I	60	9
Ungrazed Grass Site J	60	5
Ungrazed Grass Site K	60	6
Ungrazed Grass Site L2	60	13

The two month running average fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2012. Site C continues to show elevated concentrations from time to time. This issue has been discussed with Environment Southland on previous occasions and is attributed to non NZAS activities around that location.



## Ungrazed Grass Monitoring Results, continued

### Running 12 month average concentration

The following table shows the maximum 12 month running average fluoride concentrations for sites off Tiwai Peninsula during 2012.

<b>Sites off Tiwai Penninsula</b>	<b>Permit Guideline</b>  <b>mgF/kg</b>	<b>Maximum Twelve Month Running Average During 2012</b>  <b>mgF/kg</b>
Ungrazed Grass Site A	40	6
Ungrazed Grass Site B	40	5
Ungrazed Grass Site C	40	18
Ungrazed Grass Site E	40	5
Ungrazed Grass Site F	40	6
Ungrazed Grass Site G	40	7
Ungrazed Grass Site H	40	10
Ungrazed Grass Site I	40	6
Ungrazed Grass Site J	40	5
Ungrazed Grass Site K	40	3
Ungrazed Grass Site L2	40	6

The 12 month running average fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2012.

### Comments

The 2012 annual average fluoride concentrations in all ungrazed grass sites off Tiwai Peninsula were similar to the annual average fluoride concentration levels in 2011.

Sites on Tiwai Peninsula and close to the smelter are similar to concentration levels measured in previous years.

## Part G - Fluoride in *Pinus radiata*

### Introduction

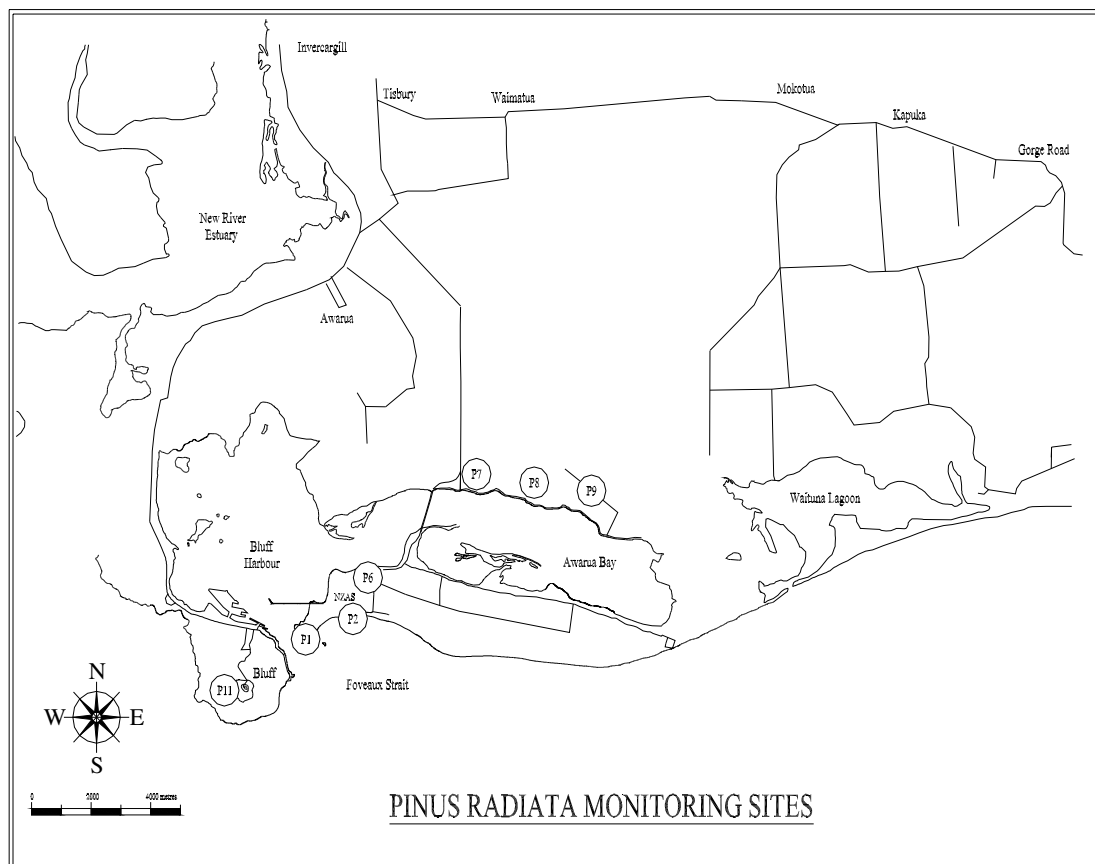
This chapter covers the monitoring of fluoride in *Pinus radiata* at seven monitoring sites located at Bluff, Awarua Plains, Waituna and Tiwai Peninsula.

### Permit Guidelines

Pine needles between one and two years old are sampled quarterly. The guideline for fluoride in washed *Pinus radiata* needles on land off Tiwai Peninsula is 75 mg/kg.

### Site Locations

The locations of the monitoring sites are shown in the following map.



## Pinus radiata Monitoring Results

The following tables summarise the monitoring results for 2011 and 2012 for the sites on and off Tiwai Peninsular. Guidelines apply only to land other than Tiwai Peninsular.

Sites on Tiwai Peninsular	Units	Guideline	2011 Average	2012 Average
P1	mg/kg	NA	17	12
P2B	mg/kg	NA	76	98
P6	mg/kg	NA	155	165

NA – Guideline not applicable.

Sites off Tiwai Peninsular	Units	Guideline	2011 Average	2012 Average
P7	mg/kg	75	7	16
P8	mg/kg	75	4	6
P9	mg/kg	75	10	9
P11	mg/kg	75	3	4

## Comments

Fluoride concentrations in *Pinus radiata* needles sites off Tiwai Peninsula were within the permit guideline during 2012. The permit guideline only applies to sites off Tiwai Peninsula.

Fluoride concentrations of pine needles at all sites off Tiwai Peninsula and close to the smelter were similar to previously recorded average levels with fluctuations within normal limits.

## Part H - Grazing Monitor Farms

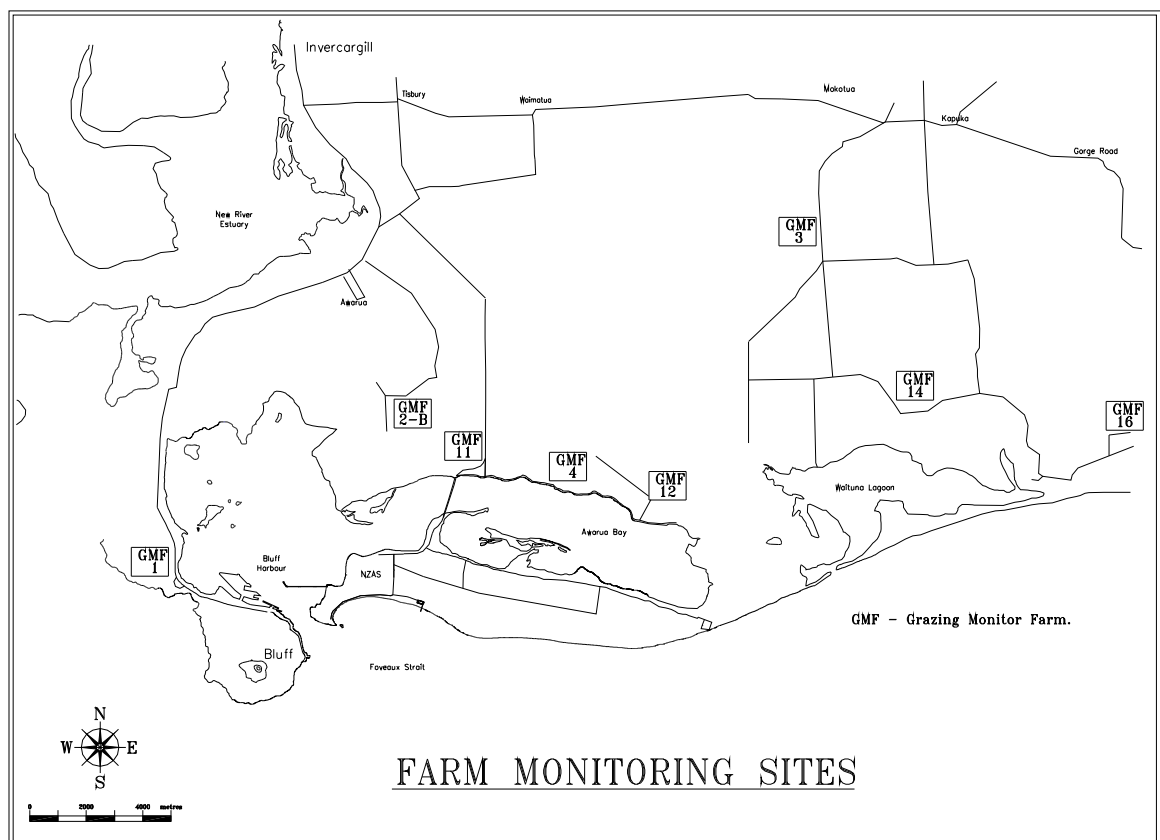
### Introduction

Air Discharge Permit Number 203378 requires NZAS to report on the effects of discharges to atmosphere on farm livestock annually.

The Grazing Monitor Project was established in 1969 prior to the smelter being commissioned. The project has continued since then with modifications as part of NZAS' Environmental Monitoring Program.

### Site Locations

The following map shows the location of the farms included in the Grazing Monitor Project.



## **Monitoring the Health of Farm Livestock**

The health of farm livestock is monitored by measuring the fluoride concentration of cattle urine.

### **Urinary fluoride**

The urinary fluoride concentrations are corrected to a specific gravity of 1.030.

## **Permit Standards**

The Air Discharge Permit contains a number of standards. A standard is defined in the permit as a limit which is not to be breached.

The standards for fluoride in grazed pasture (on an unwashed, dry weight basis) on land off Tiwai Peninsula are:

- monthly sample shall not exceed 80 mg/kg more than once in any 12 consecutive months,
- the average of any two consecutive months samples shall not exceed 60 mg/kg,
- running averages of monthly samples for a period of twelve months shall not exceed 40 mg/kg.

## **Permit Guidelines**

The Air Discharge and Coastal Permit also contain a number of guidelines. A guideline is defined in the permit as a level which is set on best current knowledge, the exceeding of which requires further investigation or other action.

The guidelines for animal health monitoring are urinary fluoride in beef cattle should not exceed 10 mg/L corrected to S.G. 1.030.

## Grazing Monitor Farm No.1

### Introduction

The following information is contained in this section:

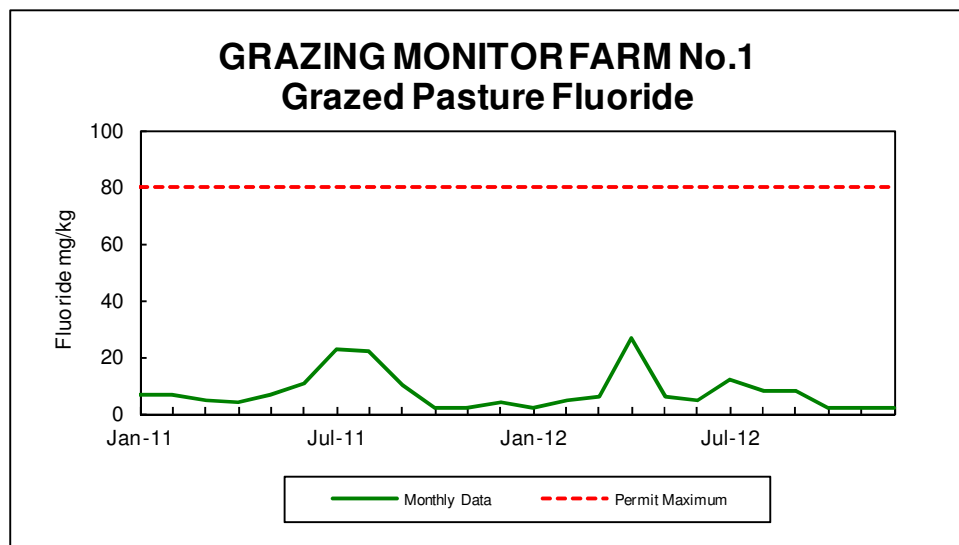
- fluoride in grazed pasture, and
- comments on the monitoring.

### Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2012.

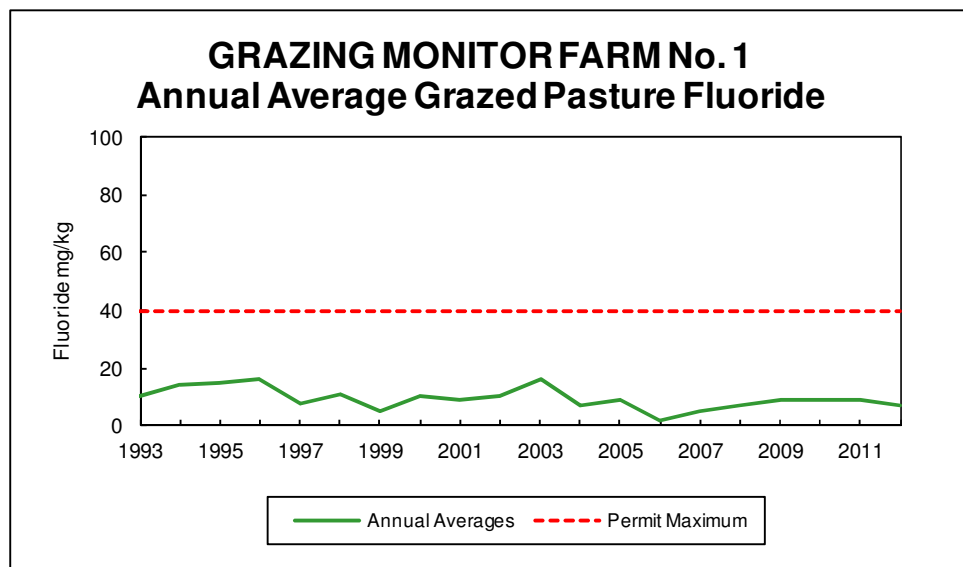
	Units	Standard	2012
Monthly sample maximum	mg/kg	80	27
Two monthly average maximum	mg/kg	60	17
Twelve monthly running average maximum	mg/kg	40	10
Annual average	mg/kg		7

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2011 and 2012.



## Grazing Monitor Farm No.1, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



### Comments

The fluoride in grazed pasture was within the permit standards. The 2012 average grazed pasture fluoride concentration of 7 mg/kg was similar to the 2011 average.

## Grazing Monitor Farm No. 2

### Introduction

The following information is contained in this section:

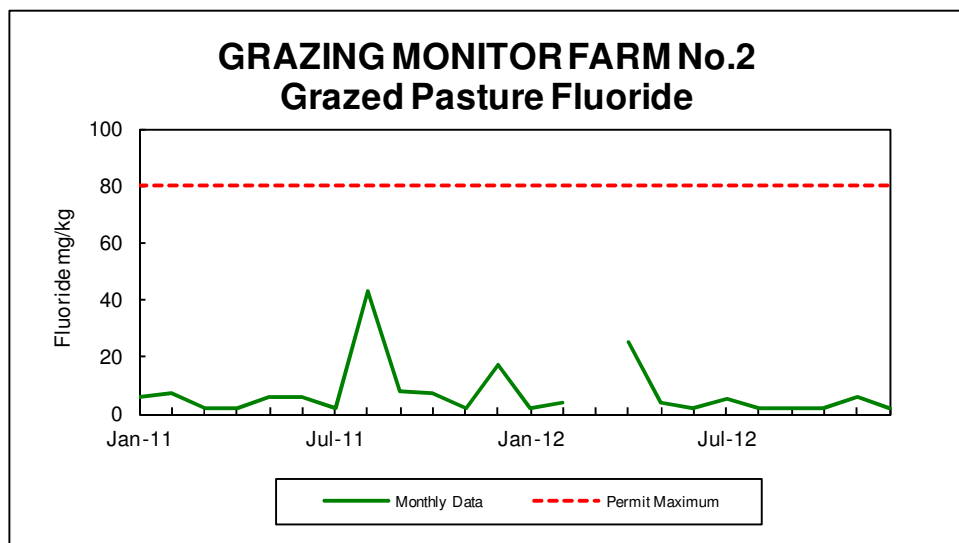
- fluoride in grazed pasture, and
- comments on the monitoring.

### Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2012.

	Units	Standard	2012
Monthly sample maximum	mg/kg	80	25
Two monthly average maximum	mg/kg	60	15
Twelve monthly running average maximum	mg/kg	40	11
Annual average	mg/kg		5

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2011 and 2012.

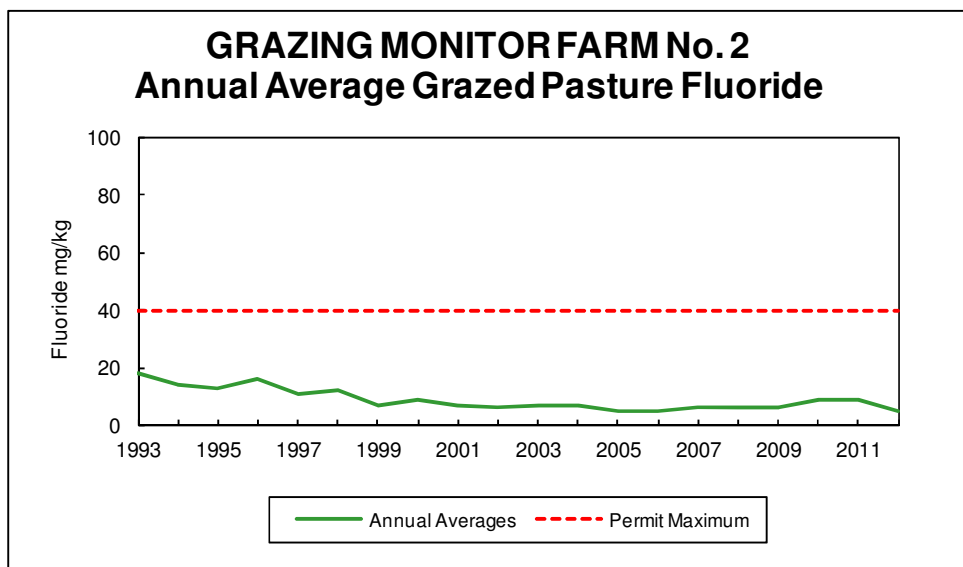


No data for March 2012 as fertilizer had been applied within 28 days of sampling.



## Grazing Monitor Farm No. 2, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



### Comments

The fluoride in grazed pasture was within the permit standards. The 2012 average grazed pasture fluoride concentration of 5 mg/kg was similar to the average fluoride concentration measured during 2011.

## Grazing Monitor Farm No. 3

### Introduction

The following information is contained in this section:

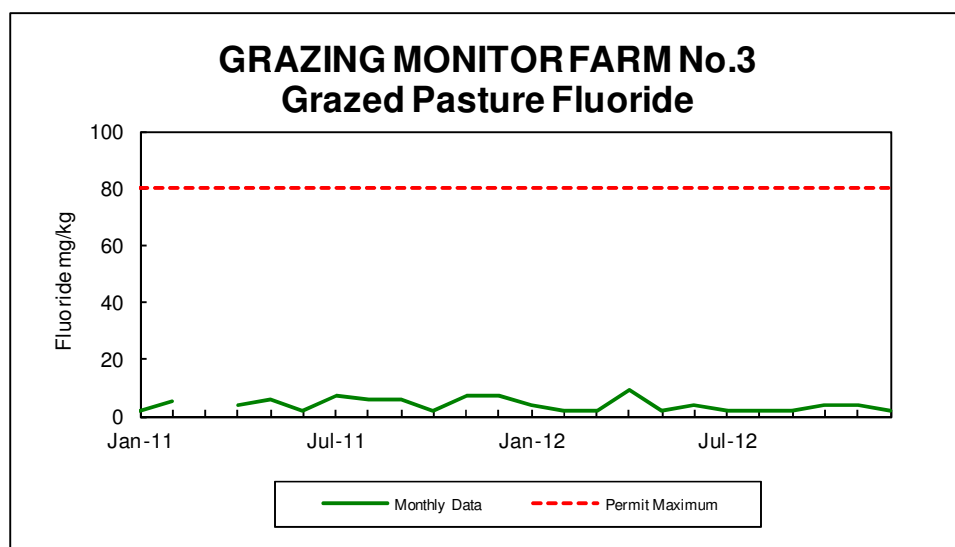
- fluoride in grazed pasture, and
- comments on the monitoring.

### Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2012.

	Units	Standard	2012
Monthly sample maximum	mg/kg	80	9
Two monthly average maximum	mg/kg	60	6
Twelve monthly running average maximum	mg/kg	40	5
Annual average	mg/kg		< 4

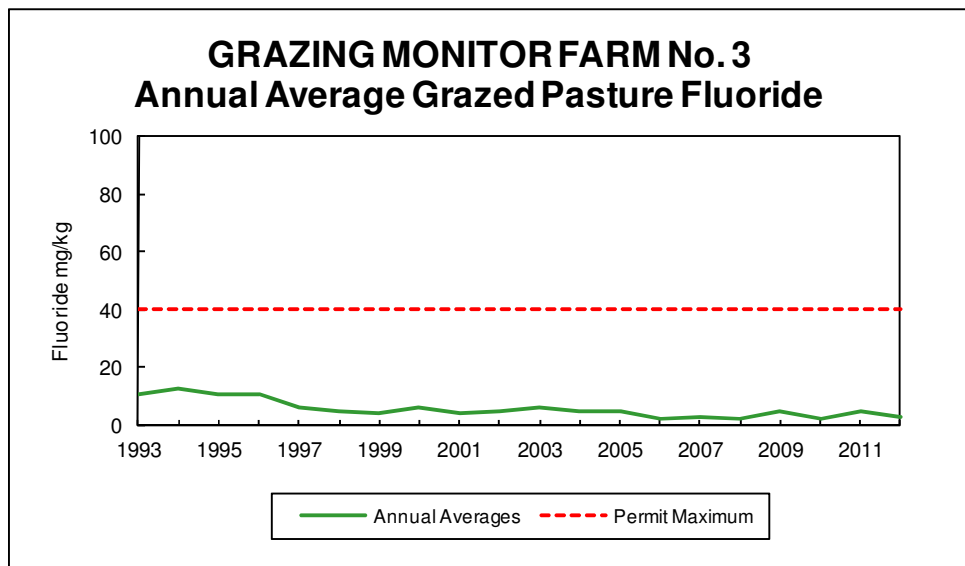
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



No data for February 2011 as fertilizer had been applied within 28 days of sampling.

## Grazing Monitor Farm No. 3, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



### Comments

The fluoride in grazed pasture was within the permit standards. The 2012 annual average grazed pasture fluoride concentration of <4 mg/kg was similar to the average fluoride concentration measured during 2011.

## Grazing Monitor Farm No. 4

### Introduction

The following information is contained in this section:

- fluoride in grazed pasture,
- cattle urinary fluoride, and
- comments on the monitoring.

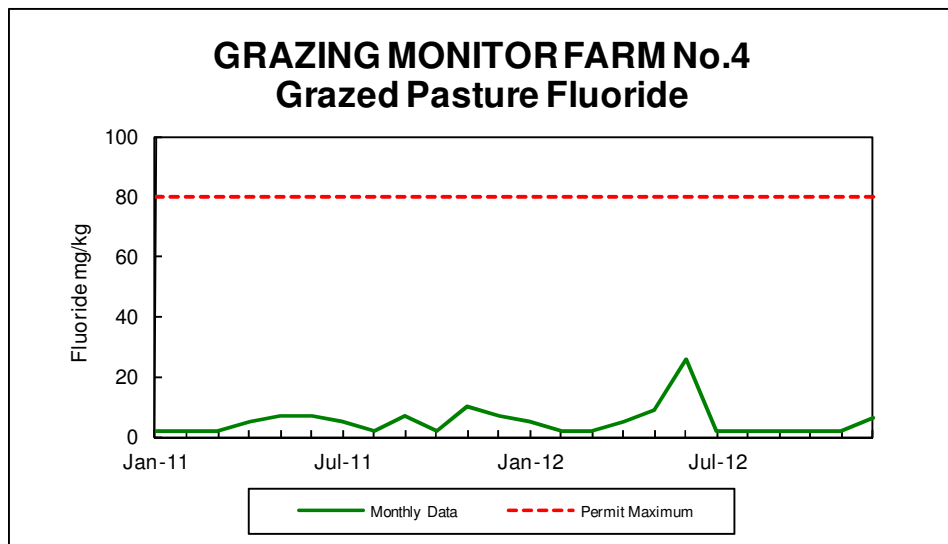
This farm was sold in late 2006 and the new owner has changed the farming practice for this farm. This farm is in the process of being converted from a sheep and cattle farm to dairy.

### Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2012.

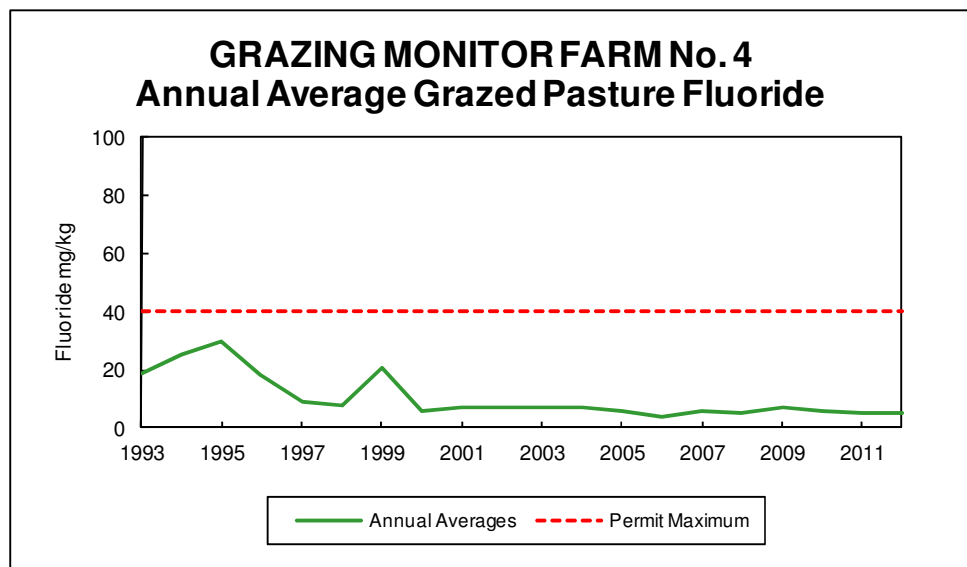
	Units	Standard	2012
Monthly sample maximum	mg/kg	80	26
Two monthly average maximum	mg/kg	60	18
Twelve monthly running average maximum	mg/kg	40	7
Annual average	mg/kg		5

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2011 and 2012.



## Grazing Monitor Farm No. 4, continued

The following graph shows the annual average fluoride concentration in grazed pasture.

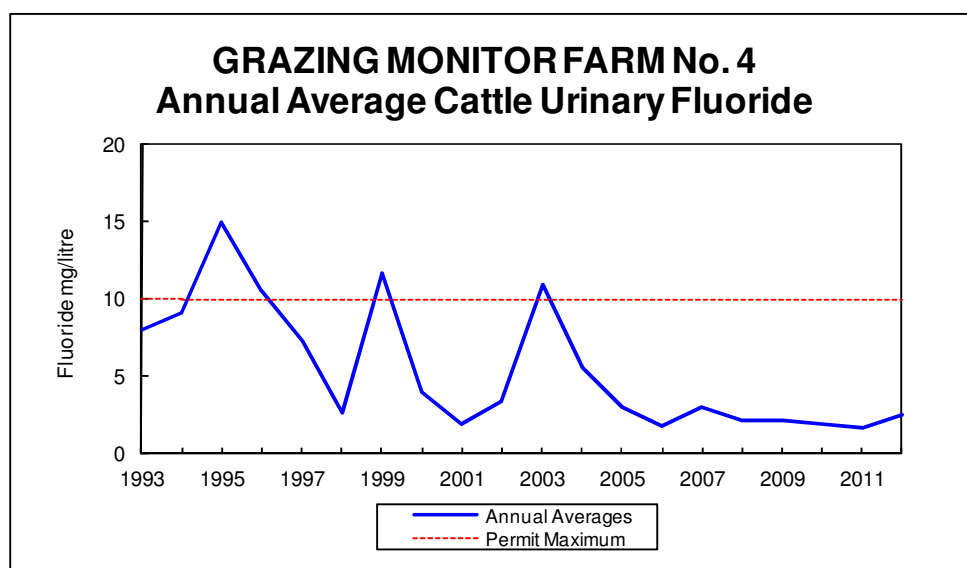


## Cattle urinary fluoride

The following table summarises the results of cattle urinary fluoride monitoring during 2012.

	Units	Guideline	2012
Average fluoride concentration	mg/L	-	2
Maximum fluoride concentration	mg/L	10	3
Minimum fluoride concentration	mg/L	-	2
No. of samples	mg/L	-	5

The following graph shows the annual average fluoride concentration in cattle urine.



## **Grazing Monitor Farm No. 4, continued**

### **Comments**

The fluoride concentrations of cattle urine and grazed pasture on GMF4 were within the permit guidelines during 2012.

The 2012 annual average grazed pasture fluoride concentration of 5 mg/kg was similar to that determined during 2011.

The annual average urinary fluoride concentration measured during 2012 was 2 mg/L similar to the average measured during 2011. It should be noted that this farm is now a dairy farm and not all the stock remains on the farm over the winter.

## Grazing Monitor Farm No. 11

### Introduction

The following information is contained in this section:

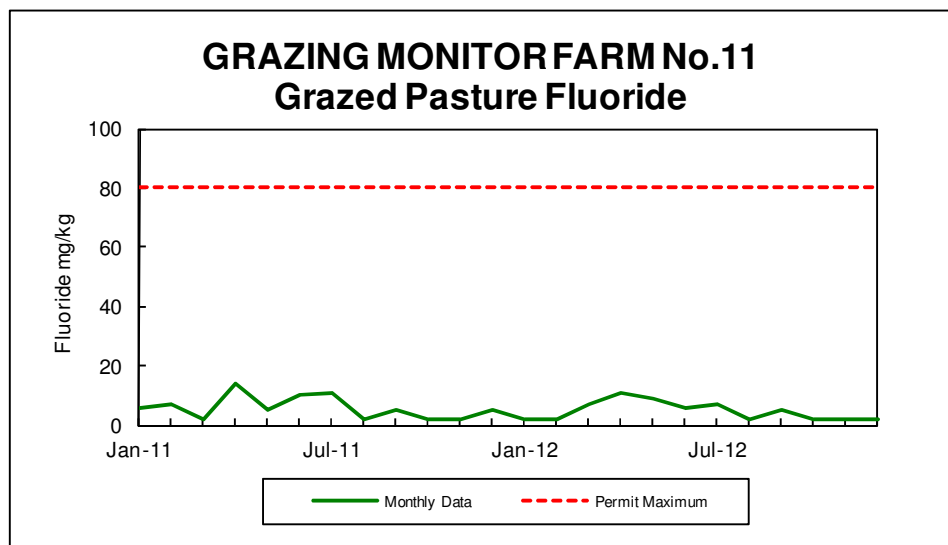
- fluoride in grazed pasture, and
- comments on the monitoring.

### Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2012.

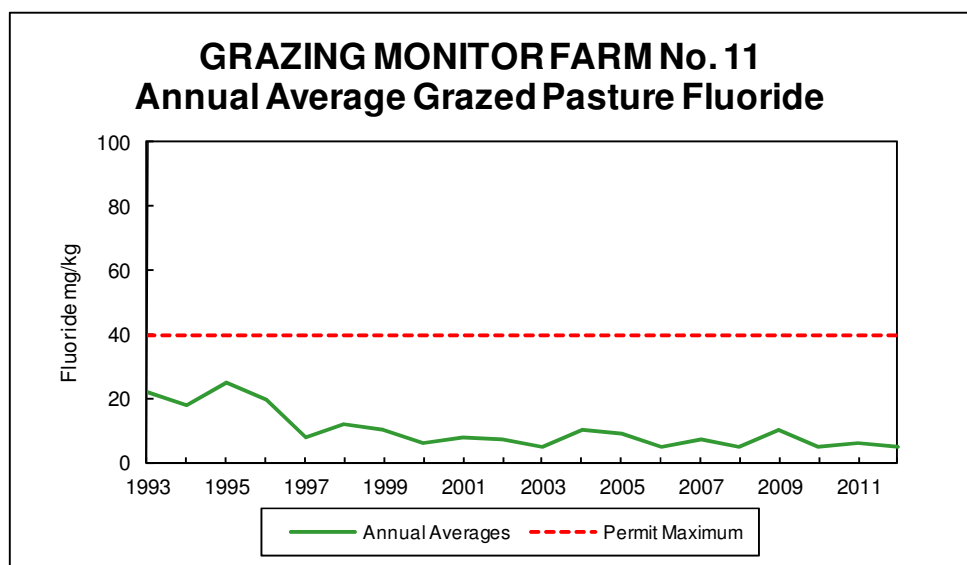
	Units	Standard	2012
Monthly sample maximum	mg/kg	80	11
Two monthly average maximum	mg/kg	60	10
Twelve monthly running average maximum	mg/kg	40	6
Annual average	mg/kg		5

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2011 and 2012.



## Grazing Monitor Farm No. 11, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



### Comments

The fluoride in grazed pasture was within the permit standards. The 2012 average grazed pasture fluoride concentration of 5mg/kg is a similar to the fluoride concentration measured during 2011.



## Grazing Monitor Farm No. 12

### Introduction

The following information is contained in this section:

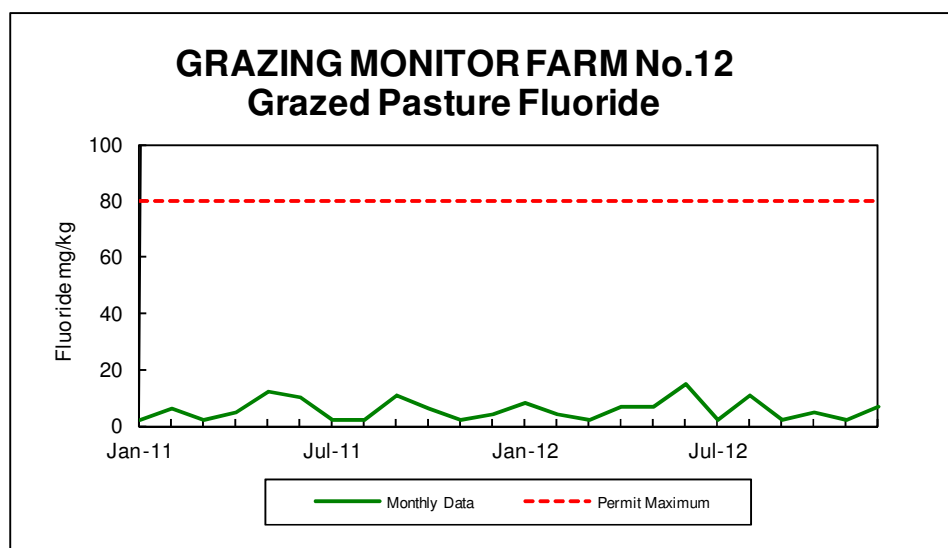
- fluoride in grazed pasture, and
- comments on the monitoring.

### Fluoride in grazed pasture

The following table shows the maximum grazed pasture monitoring results for 2012.

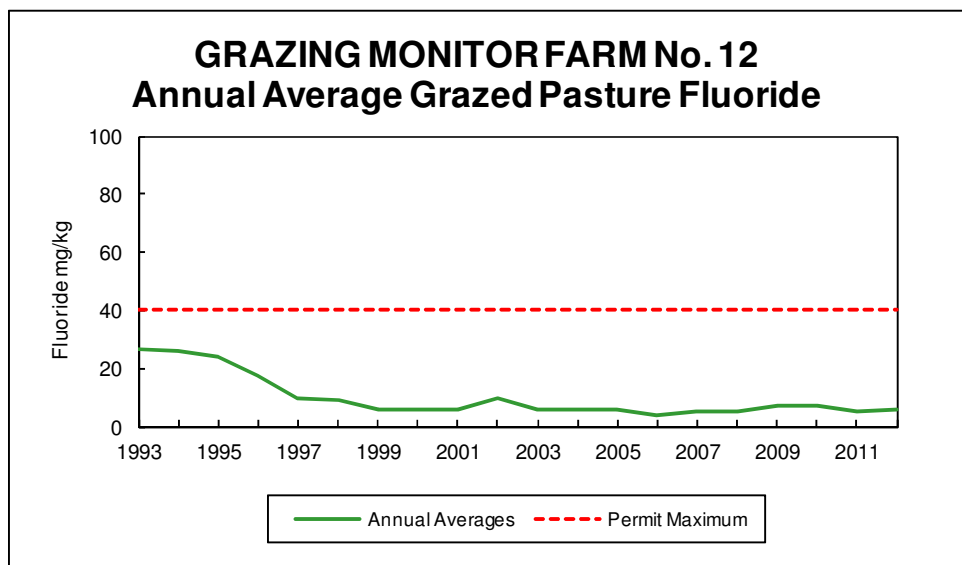
	Units	Standard	2012
Monthly sample maximum	mg/kg	80	15
Two monthly average maximum	mg/kg	60	11
Twelve monthly running average maximum	mg/kg	40	7
Annual average	mg/kg		6

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2011 and 2012.



## Grazing Monitor Farm No. 12, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



### Comments

The fluoride in grazed pasture was within the permit standards. The 2012 annual average grazed pasture fluoride concentration of 6 mg/kg is similar to the average concentration measured in 2011.

## Grazing Monitor Farm No. 14

### Introduction

The following information is contained in this section:

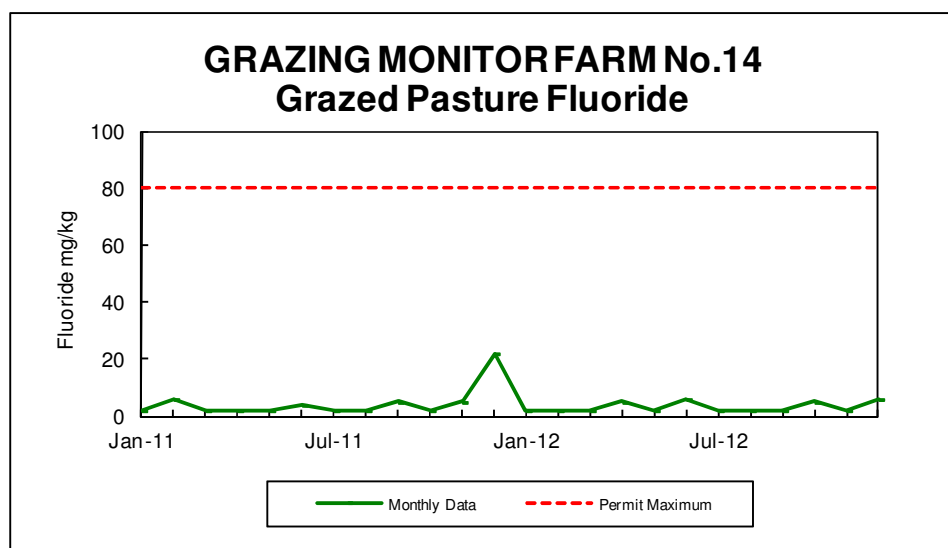
- fluoride in grazed pasture, and
- comments on the monitoring.

### Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2012.

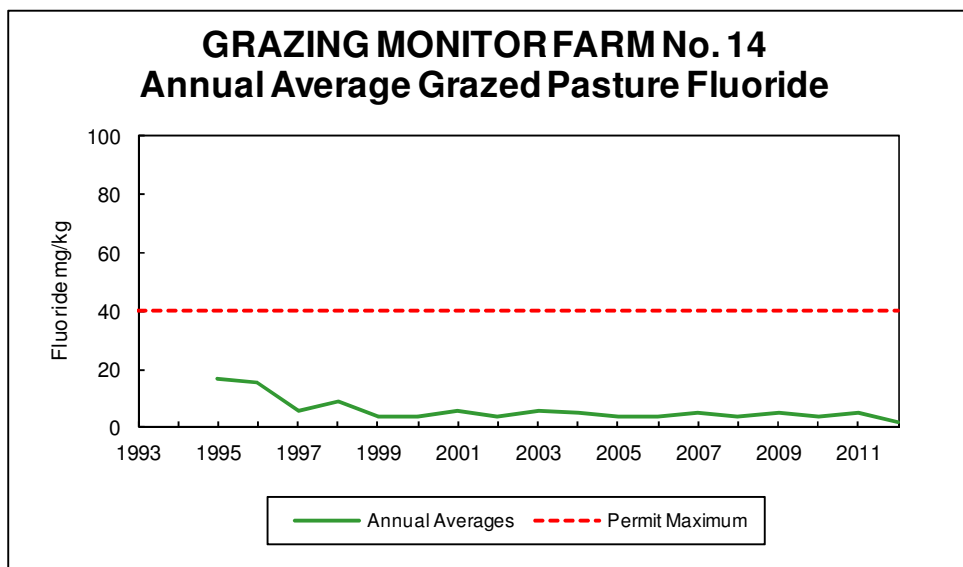
	Units	Standard	2012
Monthly sample maximum	mg/kg	80	6
Two monthly average maximum	mg/kg	60	12
Twelve monthly running average maximum	mg/kg	40	5
Annual average	mg/kg		< 4

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2011 and 2012.



## Grazing Monitor Farm No. 14, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



### Comments

The fluoride concentration in grazed pasture was within the permit standards during 2012. The 2012 annual average grazed pasture fluoride concentration of <4 mg/kg was similar to the average concentration measured during 2011.

## Grazing Monitor Farm No. 16

### Introduction

The following information is contained in this section:

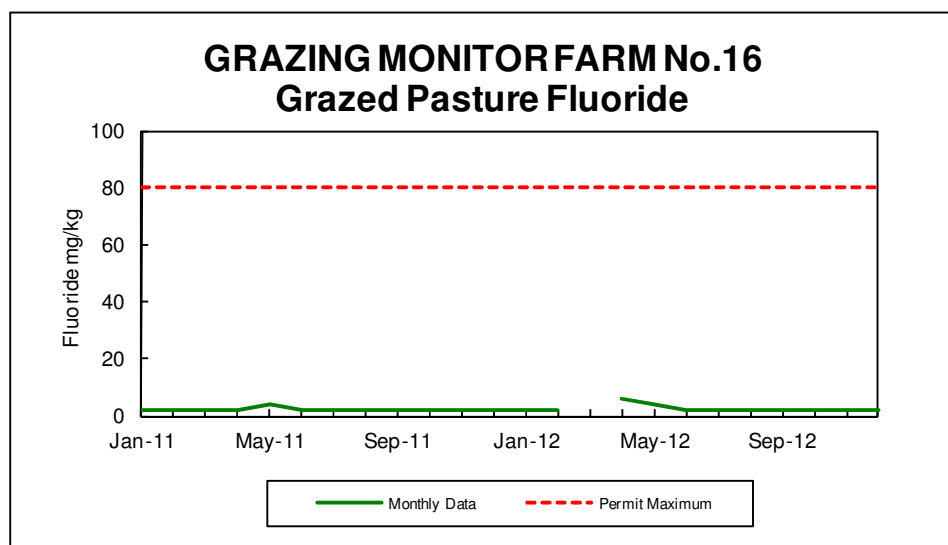
- fluoride in grazed pasture, and
- comments on the monitoring.

### Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2012.

	Units	Standard	2012
Monthly sample maximum	mg/kg	80	6
Two monthly average maximum	mg/kg	60	5
Twelve monthly running average maximum	mg/kg	40	3
Annual average	mg/kg		< 4

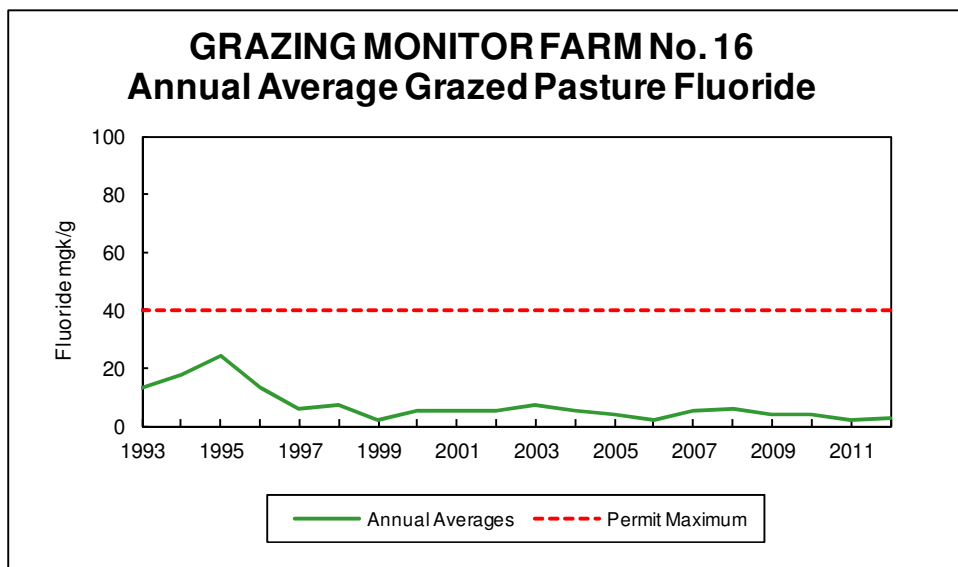
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2011 and 2012.



No data for March 2012 as fertilizer had been applied within 28 days of sampling.

## Grazing Monitor Farm No. 16, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



### Comments

The fluoride concentrations in grazed pasture were within the permit standards during 2012. The 2012 annual average grazed pasture fluoride concentration of <4 mg/kg was similar to the concentration measured in 2011.

# Part I - Water Take

## Introduction

Water Take from the aquifer on Tiwai Peninsula is covered by Consent Number 202958 issued by Southland Regional Council on the 12<sup>th</sup> September 2005.

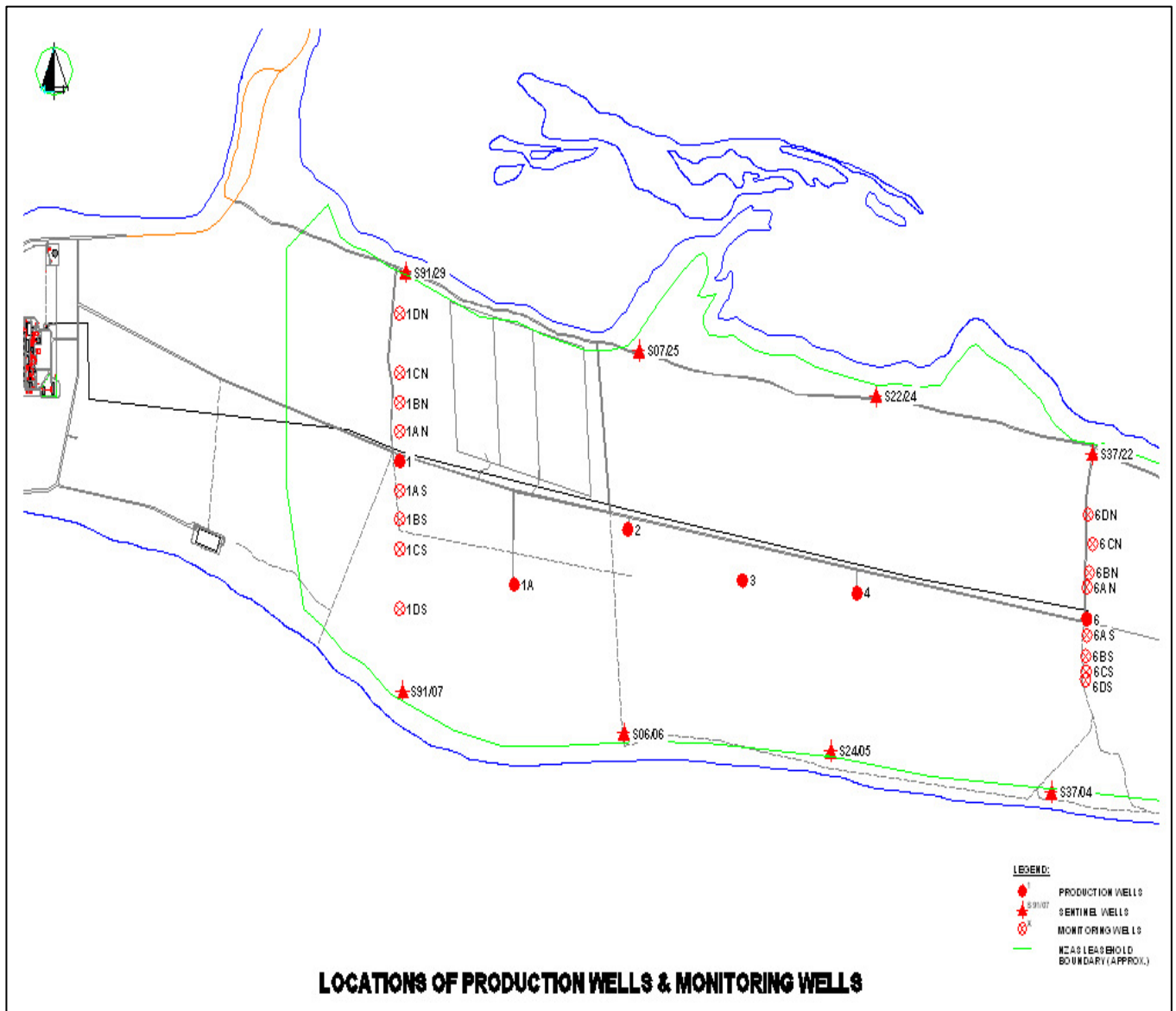
## Permit Conditions

Total abstraction rate not to exceed 4,564 m<sup>3</sup>/day.

Results of monitoring to be reported to the Council by the 31<sup>st</sup> March each year.

## Site Locations

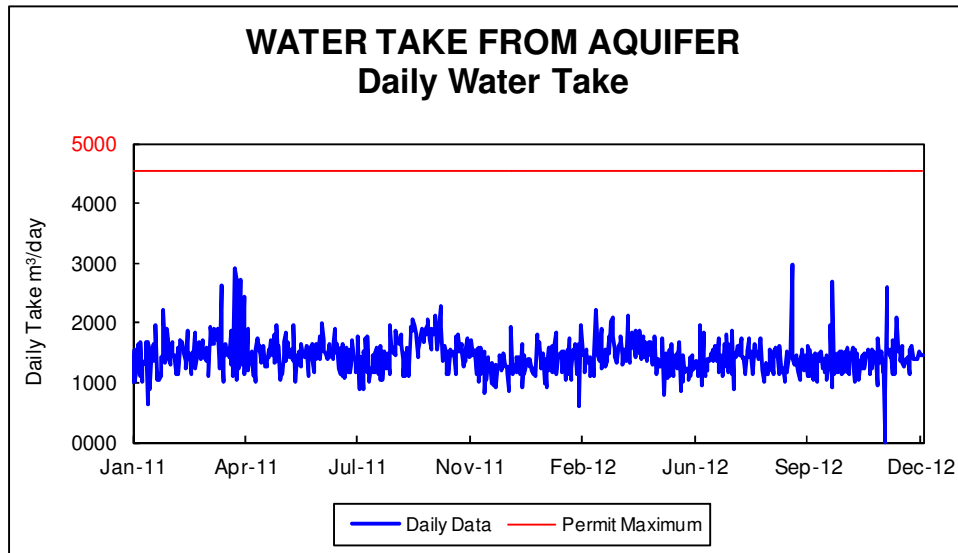
The locations of the Production and Monitoring Water Wells are shown in the following map.



## Water Take from Aquifer

### Monitoring Results

The total volume of water taken from the aquifer was recorded daily until early December 2012. Due to organisational restructuring the readings are not longer done in the weekends or public holidays. The practice now is to take the reading on the first available day and record the average. The data is displayed in the graph below.



The table below summarises the daily data on a monthly basis.

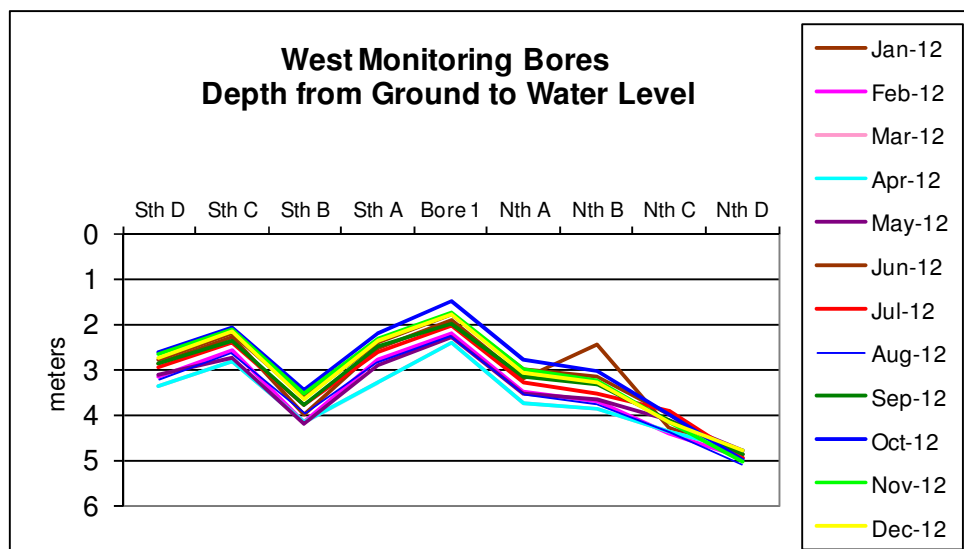
Daily Water Take		
Date	Average m <sup>3</sup> /day	Maximum m <sup>3</sup> /day
Jan-12	1383	1821
Feb-12	1365	1952
Mar-12	1546	2216
Apr-12	1559	2131
May-12	1289	1735
Jun-12	1368	1949
Jul-12	1461	1854
Aug-12	1327	1740
Sep-12	1378	2978
Oct-12	1389	2699
Nov-12	1361	2581
Dec-12	1435	2073



## Water Take from Aquifer, continued

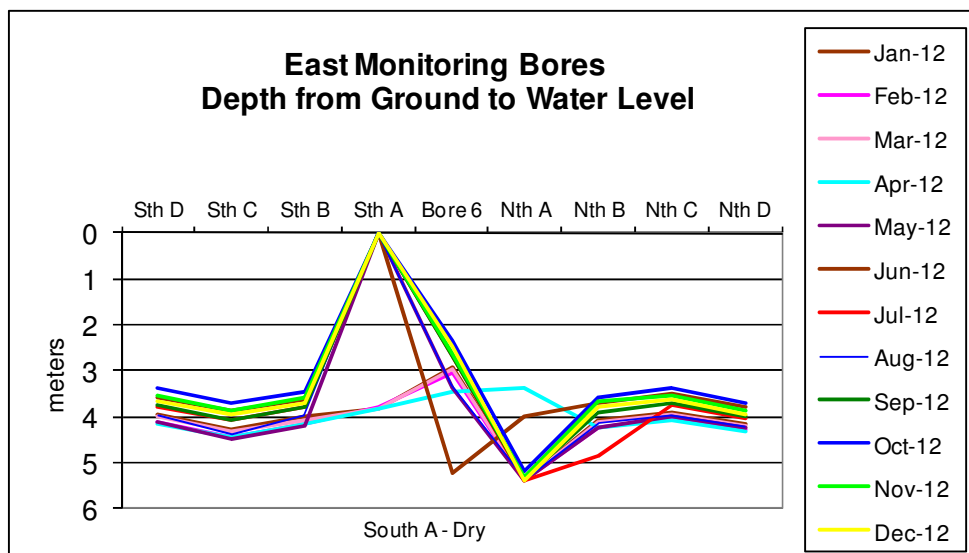
The following tables and graphs show the water level for each monitoring bore around production bores 1 and 6, measured while pumping from the production bores.

<b>West Monitoring Bore Water Levels</b> (from Mean High Sea Level in metres) <i>Total well depth in Italics</i>									
Date	South				Bore 1	North			
	D	C	B	A		A	B	C	D
	<i>5.64</i>	<i>5.50</i>	<i>5.50</i>	<i>4.62</i>	<i>16.4</i>	<i>5.32</i>	<i>5.30</i>	<i>5.55</i>	<i>5.27</i>
Jan-12	2.87	2.31	3.98	2.54	1.92	3.20	2.44	4.28	4.89
Feb-12	3.15	2.58	4.15	2.81	2.20	3.52	3.71	4.42	4.96
Mar-12	3.10	2.56	4.06	2.77	2.17	3.44	3.61	4.38	5.10
Apr-12	3.37	2.82	4.17	3.30	2.42	3.73	3.89	4.37	4.79
May-12	3.14	2.76	4.21	2.93	2.30	3.55	3.68	4.12	4.79
Jun-12	2.80	2.20	3.63	2.40	1.80	3.02	3.15	4.00	4.95
Jul-12	2.97	2.40	3.78	2.63	2.05	3.31	3.56	3.92	4.96
Aug-12	3.21	2.65	3.98	2.86	2.28	3.57	3.76	4.41	5.12
Sep-12	2.89	2.36	3.80	2.50	2.00	3.15	3.32	4.13	4.88
Oct-12	2.61	2.08	3.44	2.22	1.52	2.80	3.04	3.98	4.98
Nov-12	2.68	2.12	3.56	2.33	1.75	3.00	3.25	4.17	5.06
Dec-12	2.73	2.16	3.68	2.38	1.81	3.07	3.31	4.18	4.81



## Water Take from Aquifer, continued

<b>East Monitoring Bore Water Levels</b> (from Mean High Sea Level in metres) <i>Total well depth in Italics</i>									
Date	South				Bore 6	North			
	D <i>4.32</i>	C <i>5.35</i>	B <i>5.79</i>	A <i>3.82</i>		A <i>5.46</i>	B <i>5.4</i>	C <i>5.45</i>	D <i>5.5</i>
Jan-12	3.96	4.26	3.98	3.81	2.93	5.38	4.08	3.89	4.15
Feb-12	4.09	4.42	4.15	3.80	3.06	5.38	4.23	4.03	4.29
Mar-12	3.99	4.32	4.06	3.81	2.97	5.38	4.13	3.93	4.18
Apr-12	4.14	4.44	4.17	3.81	3.47	3.36	4.25	4.07	4.32
May-12	4.13	4.48	4.21	dry	3.37	5.37	4.23	3.99	4.23
Jun-12	3.58	3.88	3.63	dry	5.20	4.00	3.70	3.51	3.80
Jul-12	3.78	4.06	3.78	dry	2.68	5.37	4.83	3.72	4.01
Aug-12	3.97	4.37	3.98	dry	3.32	5.36	4.12	3.96	4.23
Sep-12	3.75	4.07	3.80	dry	2.69	5.35	3.89	3.71	3.99
Oct-12	3.36	3.68	3.44	dry	2.36	5.18	3.56	3.38	3.69
Nov-12	3.53	3.86	3.56	dry	2.63	5.30	3.66	3.52	3.86
Dec-12	3.66	3.93	3.68	dry	2.47	5.37	3.77	3.62	3.94



### Comments

Water levels in the monitoring bores have not changed significantly during 2012. Bore South A was dry for 8 of the 12 months as reflected in the graph above.

## Part J - Liquid Discharges and Their Effects

### Introduction

Liquid discharges from the smelter are covered by Discharge Permits issued by the Southland Regional Council. These permits commenced in June 2006.

This chapter gives details of the monitoring results for each permit.

### Permit Limits

The following table shows the permit limits applying to the discharges to water and onto land.

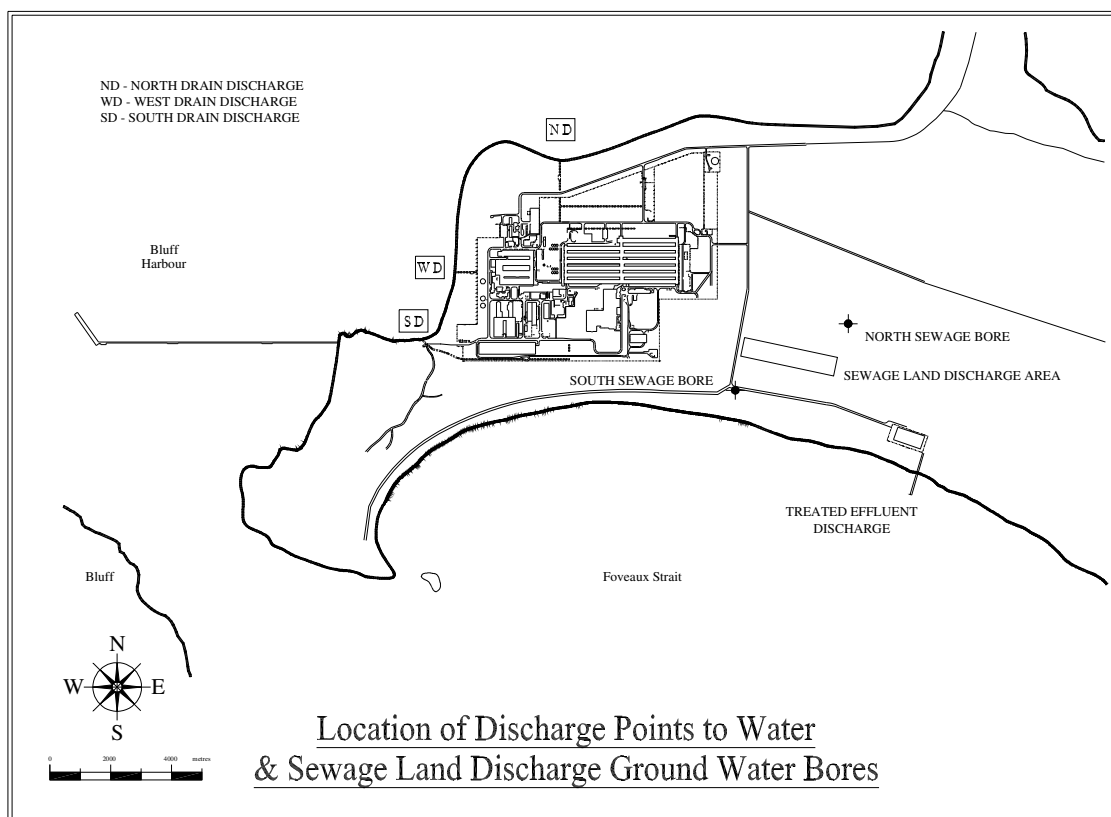
	Units	Limit
North, South, and West Drain		
• Quarterly average total suspended solids	g/m <sup>3</sup>	30
<b>Treated effluent</b>		
• Maximum daily discharge	m <sup>3</sup> /day	140
• Total suspended solids	g/m <sup>3</sup>	100
• Free cyanide	g/m <sup>3</sup>	20
<b>Treated sewage</b>		
• Maximum daily flow	m <sup>3</sup> /day	295
• Biochemical oxygen demand	kg/day	18
• Total suspended solids	kg/day	8

The following permit limits apply to coastal water monitoring sites:

- The natural temperature of the water shall not be changed by more than 3° Celsius and the natural temperature of the water shall not exceed 25° Celsius;
- Any pH change and/or any discharge of a contaminant into the water or water into water or onto the seabed shall not result in a loss of biological diversity or a change in community composition;
- The concentration of dissolved oxygen shall exceed 80% of saturation concentration;
- Fish or other aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants;
- There shall be no undesirable biological growths as a result of any discharge if a contaminant into the water;
- Aquatic life is not adversely affected by the taking of any physical, chemical or biological constituent from the water;
- Visual clarity shall not be diminished by more than twenty percent;
- The water shall not be rendered unsuitable for bathing by the presence of contaminants;
- The water shall not be altered in those characteristics which have a direct bearing upon cultural or spiritual values;
- The quarterly average fluoride concentration at drain coastal water monitoring sites shall not exceed 2 g/m<sup>3</sup> based on the results of representative samples collected each week; and
- The fluoride concentration in any representative drain coastal water monitoring sample collected weekly shall not exceed 5 g/m<sup>3</sup>.

## Site Locations

The locations of the liquid discharge and their effects monitoring sites are shown in the following map.



## Discharge Monitoring

The discharges from the North, South and West Drains are sampled once each week. The temperature of each discharge is measured once each year as part of the annual seawater quality monitoring survey.

The discharge of treated sewage is sampled over a 24 hour period once each month.

The discharge of treated effluent is sampled once per batch of treated effluent.

## Coastal Water Monitoring

Coastal water quality is determined by comparing the results of monitoring at coastal water monitoring sites with the results at control sites where coastal water monitoring sites are chosen to monitor the effects of discharges on coastal waters, and control sites are chosen to best represent the background coastal water quality.

Some coastal water monitoring is undertaken each time a drain discharge is sampled.

Additional coastal water monitoring for drain discharges is undertaken annually.

Annual coastal water monitoring is undertaken for the discharge of treated effluent.

## **Sewage Land Disposal Area Groundwater Monitoring**

Groundwater near the sewage land disposal area is monitored by sampling from one upstream bore north of the disposal area, and one downstream bore south of the disposal area.

Monitoring is carried out at about six monthly intervals.

## North Drain Discharges

### Introduction

Discharges from the North Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

### Discharge monitoring results

The following table summarises the North Drain discharge monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Average	2012 Average
Total Suspended solids	g/m <sup>3</sup>		9.3	6.9
• Maximum Quarterly Average	g/m <sup>3</sup>	30	11.5	8.7
• No. of Times Quarterly Average >30 g/m <sup>3</sup>		0	0	0
pH			7.8	8.0
Fluoride	g/m <sup>3</sup>		3.3	2.1
Conductivity	µS/cm		45785	48388

### Coastal water monitoring results

The following table summarises the North Drain weekly coastal water monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Average	2012 Average
Fluoride	g/m <sup>3</sup>		1.4	1.3
• Maximum Quarterly Average	g/m <sup>3</sup>	2	1.4	1.4
• No. of Times Quarterly Average >2.0 g/m <sup>3</sup>		0	0	0
• Maximum Individual Sample	g/m <sup>3</sup>	5	3.5	1.8
• No of Times Individual Sample > 5.0 g/m <sup>3</sup>			0	0
pH			8.1	8.1
Conductivity	µS/cm		50937	51335
Visible Oil - No. of times Observed			0	0

## North Drain Discharges continued.

### Control Site water monitoring results

The following table summarises the North Drain weekly control site water monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Result	2012 Result
Fluoride	g/m <sup>3</sup>		1.4	1.3
• Maximum Quarterly Average	g/m <sup>3</sup>		1.4	1.3
• No. of Times Quarterly Average >2.0 g/m <sup>3</sup>			0	0
• Maximum Individual Sample	g/m <sup>3</sup>		5.6	1.4
• No of Times Individual Sample > 5.0 g/m <sup>3</sup>			1	0
pH			8.1	8.1
Conductivity	µS/cm		51033	51612
Visible Oil - No. of times Observed			0	0

### Annual Monitoring results

The following table summarises the North Drain annual coastal water monitoring results during 2012 and shows a comparison with 2011 results.

Site	Parameter	Units	Limit	2011	2012
Discharge	Temperature	°C		24.1	12.1
Seawater	Temperature	°C	<25	21	12.1
	Dissolved oxygen	mg/L	>= 5	8.1	8.1
	Dissolved Oxygen Saturation	%	>80	116	100.4
Control	Temperature	°C	<25	20.3	12.4
	Dissolved oxygen	mg/L	>= 5	8.3	8.2
	Dissolved Oxygen Saturation	%	>80	117	98.4
	Change to temperature	°C	3	1	0.3

### Comments

Discharges from the North Drain were within permit limits during 2012.

## South Drain Discharges

### Introduction

Discharges from the South Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

### Discharge monitoring results

The following table summarises the South Drain discharge monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Average	2012 Average
Total Suspended solids	g/m <sup>3</sup>		2.9	2.7
• Maximum Quarterly Average	g/m <sup>3</sup>	30	3.4	3.2
• No. of Times Quarterly Average >30 g/m <sup>3</sup>		0	0	0
pH			6.9	7.0
Fluoride	g/m <sup>3</sup>		4.5	5.1
Conductivity	µS/cm		372	442

### Coastal water monitoring results

The following table summarises the South Drain weekly coastal water monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Average	2012 Average
Fluoride			1.3	1.3
• Maximum Quarterly Average	g/m <sup>3</sup>	2	1.4	1.4
• No. of Times Quarterly Average >2.0 g/m <sup>3</sup>	g/m <sup>3</sup>	0	0	0
• Maximum Individual Sample		5	1.6	1.8
• No of Times Individual Sample > 5.0 g/m <sup>3</sup>	g/m <sup>3</sup>		0	0
pH			8.1	8.1
Conductivity			49665	50982
Visible Oil - No. of times Observed			0	0



## South Drain Discharges, continued

### Control Site water monitoring results

The following table summarises the South Drain weekly control site water monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Result	2012 Result
Fluoride	g/m <sup>3</sup>		1.3	1.3
• Maximum Quarterly Average	g/m <sup>3</sup>		1.3	1.3
• No. of Times Quarterly Average >2.0 g/m <sup>3</sup>			0	0
• Maximum Individual Sample	g/m <sup>3</sup>		1.4	1.6
• No of Times Individual Sample > 5.0 g/m <sup>3</sup>			0	0
pH			8.1	8.1
Conductivity	µS/cm		50363	51136
Visible Oil - No. of times Observed			0	0

### Annual monitoring results

The following table summarises the South Drain annual water monitoring results during 2012 and shows a comparison with 2011 results. The 2011 monitoring was actually carried out in January 2012 as the drain was dry during the scheduled monitoring period.

Site	Parameter	Units	Limit	2011	2012
Discharge	Temperature	°C		13.9	13.1
Seawater	Temperature	°C	<25	13.9	12.3
	Dissolved oxygen	mg/L	>= 5	7.7	7.33
	Dissolved Oxygen Saturation	%	>80	95	89.2
Control	Temperature	°C	<25	14.1	12.4
	Dissolved oxygen	mg/L	>= 5	7.6	7.56
	Dissolved Oxygen Saturation	%	>80	94	90.4
	Change to temperature	°C	3	0	0.1

### Comments

Discharges from the South Drain were within permit limits during 2012.

## West Drain Discharges

### Introduction

Discharges from the West Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

### Discharge monitoring results

The following table summarises the West Drain discharge monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Average	2012 Average
Total Suspended solids	g/m <sup>3</sup>		9.7	11.8
• Maximum Quarterly Average	g/m <sup>3</sup>	30	11.8	18.3
• No. of Times Quarterly Average >30 g/m <sup>3</sup>		0	0	0
pH			7.6	7.8
Fluoride	g/m <sup>3</sup>		1.4	1.4
Conductivity	µS/cm		16418	17844

### Coastal water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Average	2012 Average
Fluoride			1.3	1.3
• Maximum Quarterly Average	g/m <sup>3</sup>	2	1.3	1.3
• No. of Times Quarterly Average >2.0 g/m <sup>3</sup>	g/m <sup>3</sup>	0	0	0
• Maximum Individual Sample		5	1.4	1.5
• No of Times Individual Sample > 5.0 g/m <sup>3</sup>	g/m <sup>3</sup>		0	0
pH			8.1	8.1
Conductivity			51025	51543
Visible Oil - No. of times Observed			0	0

## West Drain Discharges, continued

### Control Site water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2012 and shows a comparison with 2011 results.

Parameter	Units	Limit	2011 Result	2012 Result
Fluoride	g/m <sup>3</sup>		1.3	1.3
• Maximum Quarterly Average	g/m <sup>3</sup>		1.3	1.3
• No. of Times Quarterly Average >2.0 g/m <sup>3</sup>			0	0
• Maximum Individual Sample	g/m <sup>3</sup>		1.4	1.5
• No of Times Individual Sample > 5.0 g/m <sup>3</sup>			0	0
pH			8.1	8.1
Conductivity	µS/cm		50363	51136
Visible Oil - No. of times Observed			1	0

### Annual water monitoring results

The following table summarises the West Drain annual water monitoring results during 2012 and shows a comparison with 2011 results.

Site	Parameter	Units	Limit	2011	2012
Discharge	Temperature	°C		26	12.3
Seawater	Temperature	°C	<25	21.1	12.4
	Dissolved oxygen	mg/L	>= 5	8.4	8.32
	Dissolved Oxygen Saturation	%	>80	117	100.6
Control	Temperature	°C	<25	20.4	12.4
	Dissolved oxygen	mg/L	>= 5	8.5	7.3
	Dissolved Oxygen Saturation	%	>80	118	88.9
	Change to temperature	°C	3	1	0

### Comments

Discharges from the West Drain were all within permit limits during 2012.

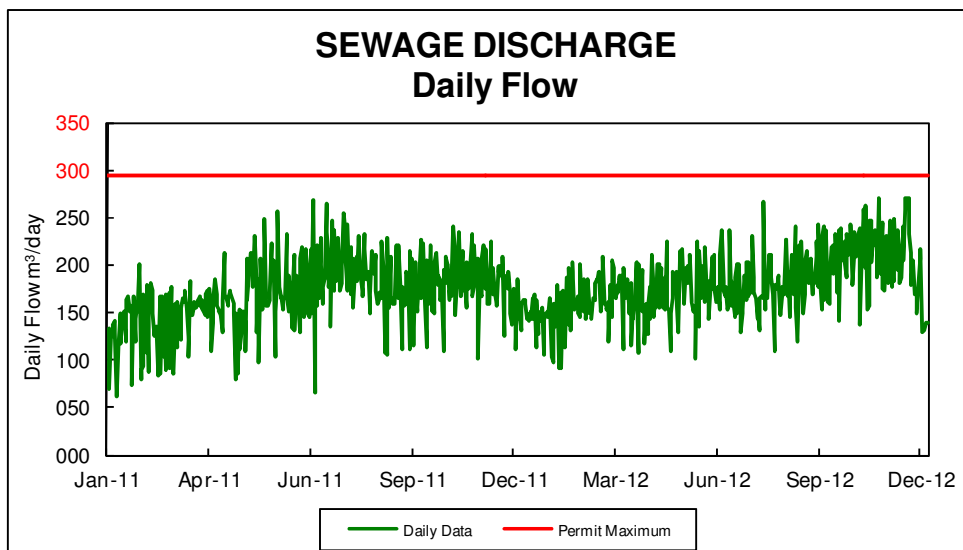
## Treated Sewage Discharges

### Introduction

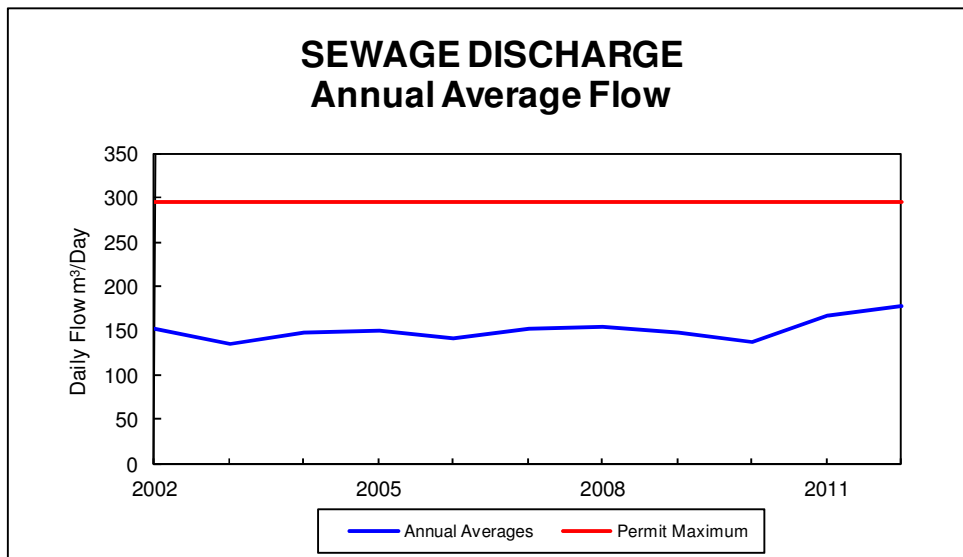
Discharges of treated sewage onto land are covered by Discharge Permit Number 203376, which was granted on 6 June 2006.

### Discharge monitoring results

The following graph shows the daily sewage discharge flow during 2011 and 2012. The permit limit for daily flow is 295 m<sup>3</sup>/day.

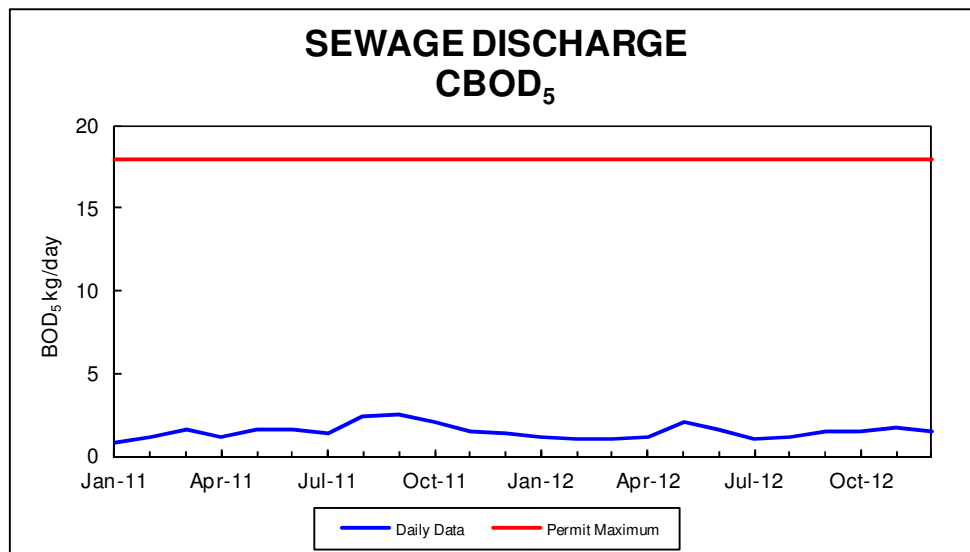


The following graph shows the annual average daily sewage discharge flow into the sewage treatment facility.

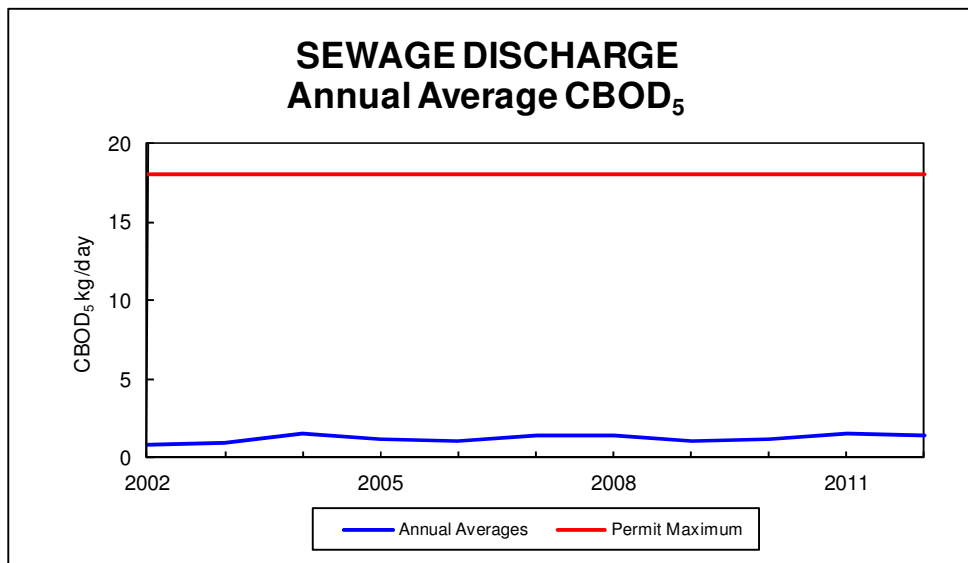


## Treated Sewage Discharges, continued

The following graph shows the monthly carbonaceous biochemical oxygen demand (CBOD<sub>5</sub>) discharge from the sewage treatment plant during 2011 and 2012. The permit limit for CBOD<sub>5</sub> is 18kg/day.

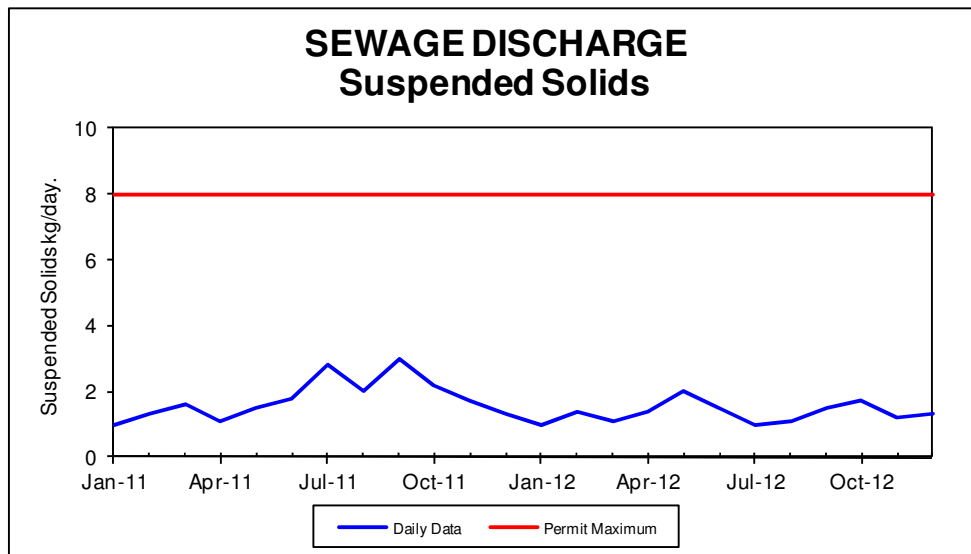


The following graph shows the annual average CBOD<sub>5</sub> discharge from the sewage treatment plant.

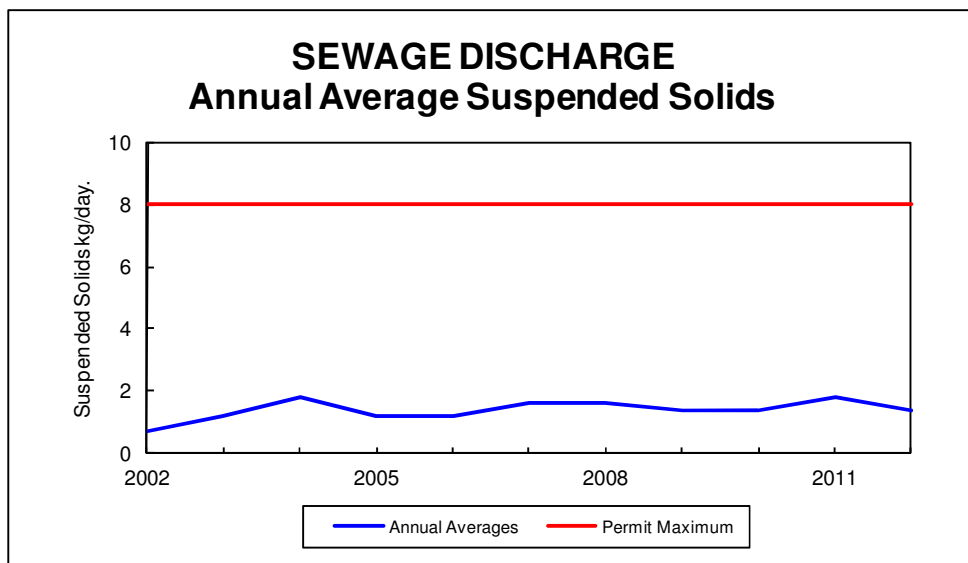


## Treated Sewage Discharges, continued

The following graph shows the monthly suspended solids discharge from the sewage treatment plant during 2011 and 2012. The permit limit for suspended solids is 8 kg/day.



The following graph shows the annual average suspended solids discharge from the sewage treatment plant.



## Treated Sewage Discharges, continued

### Land disposal area groundwater monitoring results

The following table summarises the results of groundwater monitoring near to the area where sewage is discharged to land. The location of the bores is shown in the Site Locations map on page 68.

Parameter	Units	2011 Average	2012 Average	Previous Range (post commission)
North Bore (Upstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2
Total phosphorus	g/m <sup>3</sup>	0.20	0.24	0.046 - 0.34
Total ammoniacal-N	g/m <sup>3</sup>	<0.01	< 0.01	< 0.01 - 0.03
Nitrate-N	g/m <sup>3</sup>	<0.01	<0.01	< 0.01 - 0.058
Total Nitrogen	g/m <sup>3</sup>	0.12	0.09	0.02 - 0.4
pH		7.7	8.0	7.4 - 8.1
Conductivity	µS/cm	341	363	305 - 362
Chlorinated Aliphatic HC	g/m <sup>3</sup>	N.D.	B.L.	B.L.
South Bore (Downstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2 - 65
Total phosphorus	g/m <sup>3</sup>	0.023	0.03	< 0.01 - 0.068
Total ammoniacal-N	g/m <sup>3</sup>	<0.01	<0.01	< 0.01 - 0.02
Nitrate-N	g/m <sup>3</sup>	0.26	0.30	< 0.01 - 0.54
Total Nitrogen	g/m <sup>3</sup>	0.51	0.51	0.05 - 0.78
pH		7.8	7.8	6.9 - 7.9
Conductivity	µS/cm	430	442	227 - 503
Chlorinated Aliphatic HC	g/m <sup>3</sup>	N.D.	B.L.	B.L.

Chlorinated Aliphatic Hydrocarbons only determined biennially.

### Comments

The discharges of treated sewage onto land during 2012 were similar to previously seen except for phosphorous in the upstream North Bore. The phosphorous concentration in the North Bore has shown an increase from an average of 0.07g/m<sup>3</sup> prior to 2011 to greater than 0.2g/m<sup>3</sup> in the last 2 years. The concentrations of nitrogen species has remained stable in this bore indicating it is probably not being affected by the sewage discharge.

## Treated Effluent Discharges

### Introduction

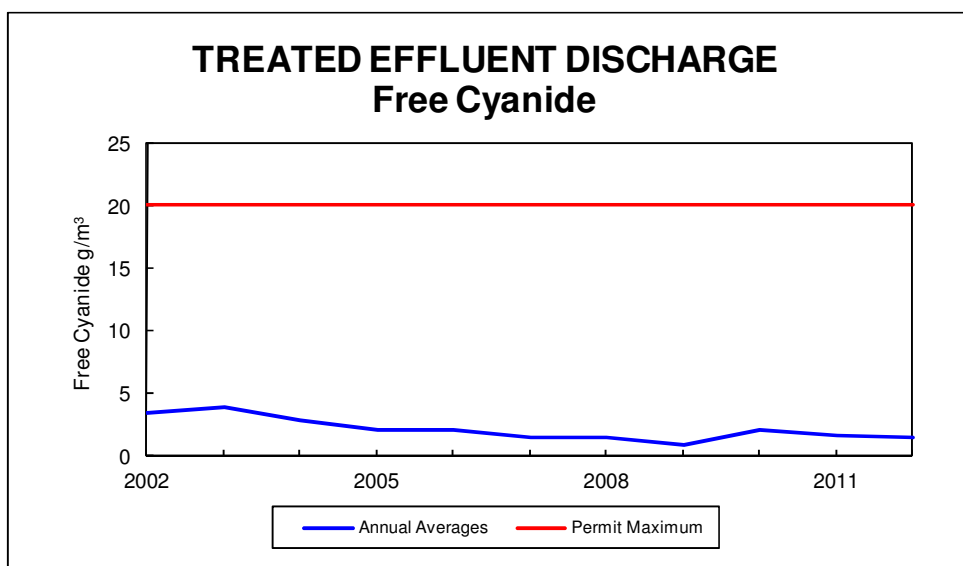
Discharges of treated effluent into Foveaux Strait are covered by Coastal Permit Number 203375 which commenced on 6 June 2006.

### Discharge monitoring results

The following table summarises the results of treated effluent discharge monitoring during 2012 and shows a comparison with the 2011 results.

Parameter	Units	Limits	2011 Result	2012 Result
Maximum daily discharge	m <sup>3</sup> /day	140	80	80
Suspended Solids				
Maximum Concentration			34	93
Average Concentration	g/m <sup>3</sup>	100	8.1	14.1
No.> 100 g/m <sup>3</sup>		0	0	0
Free Cyanide				
Maximum Concentration	g/m <sup>3</sup>	20	4.1	3.7
Average Concentration			1.6	1.4
No.> 20 g/m <sup>3</sup>		0	0	0

The following graph shows the annual average free cyanide concentration of treated effluent discharged.

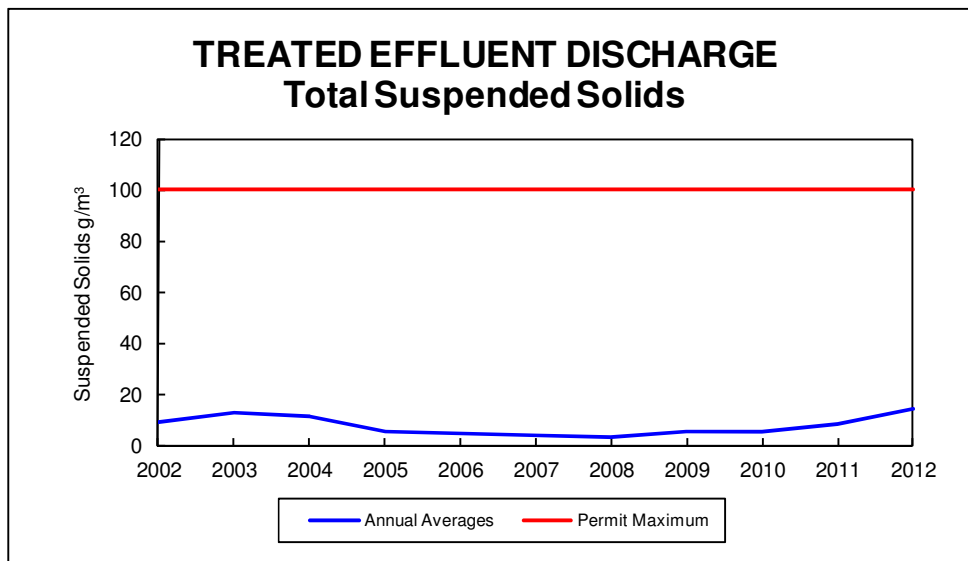




## Treated Effluent Discharges, continued

### Discharge monitoring results, continued

The following graph shows the annual average total suspended solids concentration of treated effluent discharged.



### Discharge rate

The following table shows the average, maximum and minimum discharge rates for the discharge of treated effluent to Foveaux Strait during 2010, 2011 and 2012. There were 28 discharges throughout 2012 with a total volume of 2240 m<sup>3</sup> discharged.

Parameter	Units	2010 Result	2011 Result	2012 Result
Average Discharge Rate	L/min	5	5	5
Maximum Discharge Rate	L/min	5	5	5
Minimum Discharge Rate	L/min	5	5	5

## Treated Effluent Discharges, continued

### Annual Coastal Water Monitoring Results

The following table summarises the annual coastal water monitoring for the discharge of treated effluent.

Site	Parameter	Units	Limit	2011	2012
Coastal	Fluoride	g.m <sup>-3</sup>		1.3	1.3
	Total Cyanide	g.m <sup>-3</sup>		<0.006	<0.006
	Conductivity	µS/cm		52400	51000
	pH			8.2	8.1
	Dissolved Oxygen	mg/L	≥5	7.8	8.3
	% Saturation	%	>80	95	101.8
	Temperature	°C	<25	14	13
Control	Fluoride	g.m <sup>-3</sup>		1.3	1.3
	Total Cyanide	g.m <sup>-3</sup>		<0.006	<0.006
	Conductivity	µS/cm		52500	51100
	pH			8.3	8.1
	Dissolved Oxygen	mg/L	≥5	7.7	8.75
	% Saturation	%	>80	95	102.1
	Temperature	°C	<25	14.1	13
	Change to Temperature	°C	3	0	0

### Condition of the diffuser

The Cathode Outfall Discharge Structure including the diffuser was inspected on 1<sup>st</sup> December 2012. The structure on inspection was found to be in good condition upright on the seafloor as intended. Growth on the structure was found to be similar to other years. The structure was scraped clean making sure to leave any small snails in place. These seem to stop the sea tulips attaching themselves to the structure. The anchor chain was found to be well worn and need of replacement. This work, along with replacing shackles and rewelding the anchor point to the buoy was carried out on the 9<sup>th</sup> of December 2012.



Photos of before and after cleaning.

### Comments

All discharges of treated effluent were within permit limits during 2012.

# Part K - Landfill Operations

## Introduction

Operation of the landfill on the smelter's Tiwai Point property is covered by Discharge Permit No. 202196 issued by the Southland Regional Council on 8 December 2004.

This report covers:

- proposed operation at the landfill for the next twelve months,
- comments on operations for 2012, and
- groundwater monitoring.

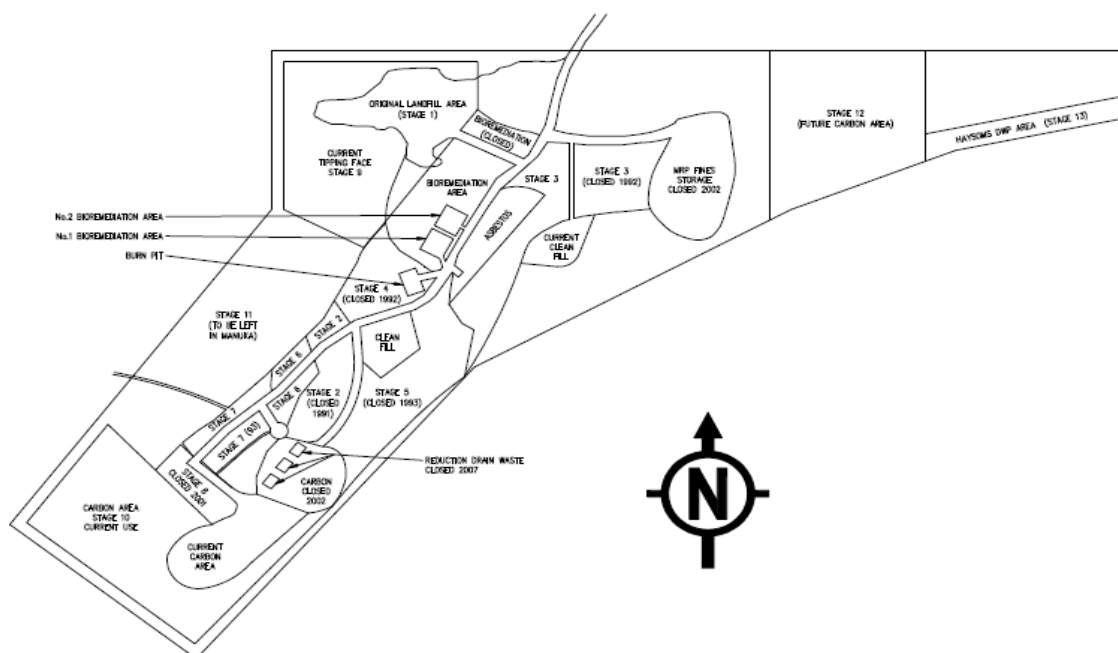
## Proposed Operation For 2013

### Introduction

The proposed operation of the landfill is outlined in the NZAS Landfill Management Plan. Additional details on the proposed operations during 2012 are included in the following sections.

### Landfill areas being developed or extended

The following map shows the current landfill disposal and storage areas.



### General Waste

The general waste tip face is heading in a Northerly direction, towards the general waste area access road. Once it reaches the access road the enclosed area will then be completely filled. It is anticipated that this will take many years. The general waste area is being progressively capped with pea gravel and timber mulch as per the Landfill Management Plan.

## **Landfill areas being developed or extended, continued**

### **Carbon Waste**

The Stage Ten carbon dust tipping area was opened in 2002 and it is anticipated that operation will continue through 2013. The carbon is being layered at the South East end of the Carbon tipping area. It will be taken up to the same height as the Lined Carbon area. Once this area is completed the fill will head directly north to fill the rest of the available area. However access into the carbon tipping area by truck is becoming problematic from a safety perspective. Should a point be reached that safety could be compromised then the current tipping area may be closed before the entire available volume is occupied.

If early closure becomes a reality, a new carbon tipping area will need to be opened. The NZAS consent allows for a new tipping area, Stage 12, to be opened. Investigations into possible alternative tipping areas are continuing including the possibility of backfilling the MRP area as the dross is mined out by Taha.

### **Comments on Operations for 2013**

#### **Man Made Mineral Fibre Area**

The existing man made mineral fibre bunker was completely filled during 2011 and a new storage area was created directly north of the previous bunker which was utilised throughout 2012. Operations will continue in this area over 2013.

#### **Metal Reclamation Plant Stockpile**

The MRP area was re-opened in July 2011 and the pea gravel cover pulled back to expose the process material. Intermittent loads of MRP material have been trucked to the Taha plant for the aluminium to be extracted. This will continue through 2013 with extraction rates anticipated to rise to full plant capacity of 30 tonnes per day by the end of 2013. Once full capacity is achieved, complete removal of dross from the MRP stockpile should be completed within four to five years.

#### **Carbon Dust Tipping Area**

As noted above.

#### **Timber Stockpile**

Until late 2012 timber pallets were being recycled via Southland Disability Enterprises. However due to a change in pallet specification, the volume of pallets available to be recycled was significantly reduced. Pallets not suitable for recycling are now being stockpiled at the general waste tipping area in preparation for a six monthly chipping programme. Chipped timber will be used for landfill cover as per the Landfill Management Plan. This practice will continue indefinitely unless an alternative recycling route is made available.

## Amount and Type of Materials Deposited

### Introduction

As per NZAS' consent conditions for landfill operations, a report detailing waste sent to landfill is required to be submitted every second year. The last full report was for the calendar year 2011.

Previously it has been NZAS practice to report in the intervening years using the same data collection methodology. However this practice has been discontinued from 2012 as it relied on the availability of summer vacation students to collect and report on the waste volumes sent to landfill. Due to the worsening financial situation in 2012, the decision was taken to cut back on the number of summer vacation students which has meant that resource was not available to undertake the non-process waste survey for 2012.

### Non-Process Waste

The results for non-classifiable waste are very variable from year to year. The average for the last 10 years is 896 tonnes. A figure of 900 tonnes was used for the average annual contribution from non-process waste reported in 2012.

No mayor upgrade or expansion of the Plant is planned for the foreseeable future so the amount of waste is likely to stay stable for the next few years ahead. It is proposed that the average weight of 900 tonnes is used as an estimate for future reporting of non-classifiable waste deposited at the NZAS landfill.

### Process Waste

Process waste continues to be weighed on a skip by skip basis and is reported below.

Measured Process Waste to the NZAS Landfill By Material 2009 - 2012				
Material	2009	2010	2011	2012
Alumina	22	87	45	25
Carbon	2173	2310	2147	2389
Furnace Slag	154	154	164	171
Reject Bath	40	102	123	85
Resistor Coke	635	191	245	330
Miscellaneous	58	39	153	120
<b>Total Process (tonnes)</b>	<b>3082</b>	<b>2883</b>	<b>2877</b>	<b>3120</b>

The total amount of process waste in 2012 was slightly higher than seen in the last two years but similar to 2009 data. More carbon was landfilled in 2012 compared to the last three years.

### Total Waste

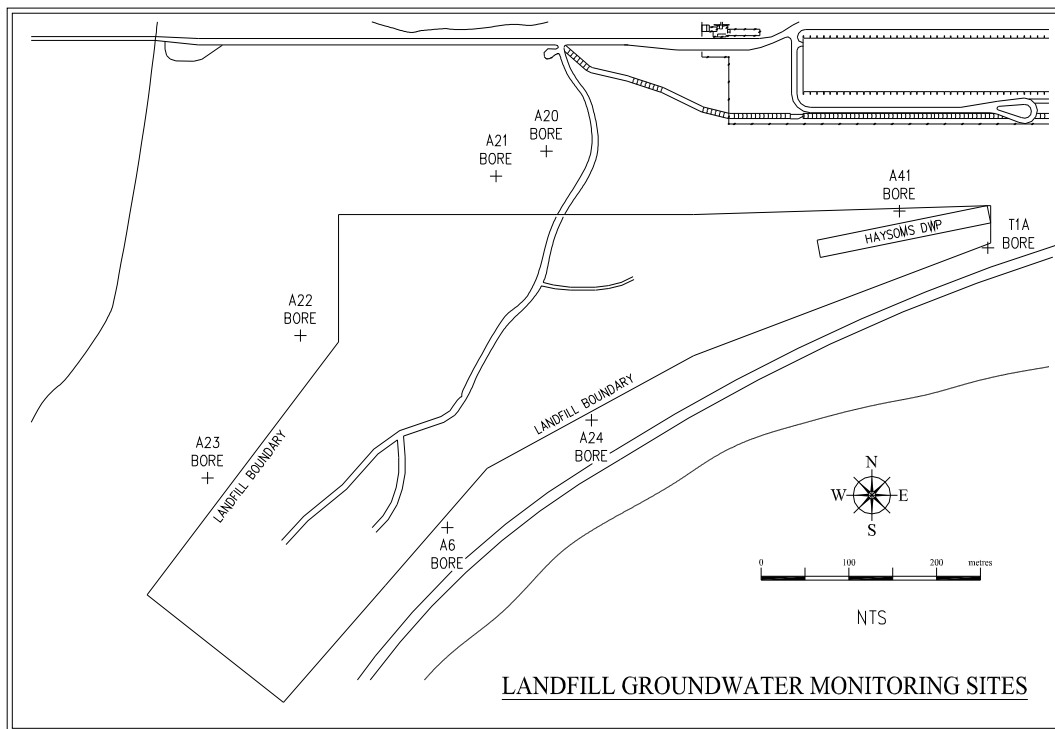
The total amount of waste sent to landfill is displayed in the table below.

Total Waste to the NZAS Landfill 2009 – 2012				
Material	2009	2010	2011	2012
Non-Process Waste	1417	985	753	900
Process Waste	3082	2883	2877	3120
<b>Total Waste (tonnes)</b>	<b>4499</b>	<b>3868</b>	<b>3630</b>	<b>4020</b>

## Landfill Groundwater Monitoring

### Site locations

The locations of the groundwater monitoring bores are as shown in the following map. Three of the bores are north (upstream) of the landfill, and there are three bores south east and two bores west (downstream) of the landfill.



## Landfill Groundwater Monitoring, Continued

### Bore A20 monitoring results

The table below shows a summary of results from samples collected from bore A20 during 2011 and 2012. Bore A20 is located north of the landfill (upstream).

Analyte	Units	2011	2012	Range (since Commissioning)
		Average	Average	
Temperature	°C	8.7	N.D.	7.5 - 13.4
pH		5.9	5.85	5.1 - 7.2
Conductivity	µS/cm	956	973	644 - 1063
Alkalinity	g/m <sup>3</sup>	20	22	8 - 240
Carbonaceous BOD5	g/m <sup>3</sup>	<1	1.00	<1 - 6
Total Nitrogen	g/m <sup>3</sup>	1.28	0.97	0.1 - 1.68
Total Ammoniacal Nitrogen	g/m <sup>3</sup>	0.31	0.16	0.02 - 0.34
Fluoride	g/m <sup>3</sup>	1.29	0.81	0.03 - 11
Sulphate	g/m <sup>3</sup>	32	46	25 - 55
Total Iron	g/m <sup>3</sup>	11.30	5.95	0.46 - 26
Total Petroleum Hydrocarbons	g/m <sup>3</sup>	0.5	N.D.	<1 - 11.6
Total Kjeldahl Nitrogen	g/m <sup>3</sup>	1.265	0.94	0.2 - 1.67
Nitrate Nitrogen	g/m <sup>3</sup>	0.014	N.D.	<0.002 - 14
Nitrite Nitrogen	g/m <sup>3</sup>	0.003	N.D.	<0.002 - 0.014
Weak Acid Dissociable Cyanide	g/m <sup>3</sup>	<0.001	N.D.	<0.001 - 0.1
Boron	g/m <sup>3</sup>	0.032	N.D.	0.032 - 0.067
Manganese	g/m <sup>3</sup>	0.111	N.D.	0.111 - 0.394
Nickel	g/m <sup>3</sup>	0.0018	N.D.	0.0018 - 0.01
Potassium	g/m <sup>3</sup>	3.7	N.D.	2.9 - 4.1
Vanadium	g/m <sup>3</sup>	0.003	N.D.	<0.001 - 0.0079

N.D: Not analysed – only required biennially.

## Landfill Groundwater Monitoring, Continued

### Bore A21 monitoring results

The table below shows a summary of results from samples collected from bore A21 during 2011 and 2012. Bore A21 is located north of the landfill (upstream).

Analyte	Units	2011 Average	2012 Average	Range (since Commissioning)
Temperature	°C	7.7	N.D.	6.5 - 13.7
pH		6.1	6.2	5.1 - 6.9
Conductivity	µS/cm	896	838	502 - 1723
Alkalinity	g/m <sup>3</sup>	36	53	9 - 160
Carbonaceous BOD5	g/m <sup>3</sup>	1.20	3	<1 - 16
Total Nitrogen	g/m <sup>3</sup>	3.05	3.0	0.7 - 8
Total Ammoniacal Nitrogen	g/m <sup>3</sup>	1.4	1.8	0.1 - 4.6
Fluoride	g/m <sup>3</sup>	3.0	2.5	0.2 - 3.8
Sulphate	g/m <sup>3</sup>	34	32	8 - 114
Total Iron	g/m <sup>3</sup>	17.7	15.3	2.2 - 94.6
Naphthalene	mg/m <sup>3</sup>	<1	0.5	<0.1 - 1
Anthracene	mg/m <sup>3</sup>	<0.4	0.13	<0.02 - 0.2
Phenanthrene	mg/m <sup>3</sup>	<0.4	<0.5	<0.005 - 0.2
Fluoranthene	mg/m <sup>3</sup>	<0.4	0.13	<0.02 - 0.2
Total Petroleum Hydrocarbons	g/m <sup>3</sup>	0.5	N.D.	<1 - 7.3
Total Kjeldahl Nitrogen	g/m <sup>3</sup>	3.05	2.9	0.8 - 6.5
Nitrate Nitrogen	g/m <sup>3</sup>	0	N.D.	0 - 29
Nitrite Nitrogen	g/m <sup>3</sup>	0.007	N.D.	<0.002 - 0.028
Weak Acid Dissociable Cyanide	g/m <sup>3</sup>	0.0005	N.D.	<0.001 - 0.1
Boron	g/m <sup>3</sup>	0.08	N.D.	0.07 - 0.154
Manganese	g/m <sup>3</sup>	0.088	N.D.	0.064 - 0.473
Nickel	g/m <sup>3</sup>	0.0026	N.D.	<0.0005 - 0.007
Potassium	g/m <sup>3</sup>	5.6	N.D.	5 - 11
Vanadium	g/m <sup>3</sup>	0.0176	N.D.	0.001 - 0.043

N.D: Not analysed – only required biennially.



## Landfill Groundwater Monitoring, Continued

### Bore A41 monitoring results

The table below shows a summary of results from samples collected from bore A41 during 2011 and 2012. Bore A41 is located north of the Hansoms' area (upstream).

Analyte	Units	2011 Average	2012 Average	Range (since Commissioning)
pH	-	6.3	6.55	6.2 - 7.9
Alkalinity	g/m <sup>3</sup>	24	58	11.9 - 170
Temperature	°C	11.2	N.D.	6.2 - 7.9
Conductivity	µS/cm	526	586	282 - 984
Carbonaceous BOD <sub>5</sub>	g/m <sup>3</sup>	0.5	1	0.5 - 1
Fluoride	g/m <sup>3</sup>	1.2	3.7	0.25 - 4.4
Sulphate	g/m <sup>3</sup>	24	26	19.2 - 47
Total Iron	g/m <sup>3</sup>	0.06	0.05	0.04 - 0.63
Boron	g/m <sup>3</sup>	0.04	N.D.	0.04 - 4.1
Manganese	g/m <sup>3</sup>	<0.01	N.D.	<0.01 - 0.023
Potassium	g/m <sup>3</sup>	1.09	N.D.	0.27 - 4.8
Vanadium	g/m <sup>3</sup>	0	N.D.	<0.002 - 0.011
Nickel	g/m <sup>3</sup>	0.0005	N.D.	0.0005 - 0.004
Ammoniacal-Nitrogen	g/m <sup>3</sup>	0.0275	0.01	0.005 - 0.16
Total Nitrogen	g/m <sup>3</sup>	4	7	0.75 - 26
Total Kjeldahl Nitrogen	g/m <sup>3</sup>	0.49	0.605	0.41 - 3.1
Nitrate Nitrogen	g/m <sup>3</sup>	0.34	N.D.	0.269 - 23
Nitrite Nitrogen	g/m <sup>3</sup>	0	N.D.	<0.002 - 0.2
Total Petroleum Hydrocarbons	g/m <sup>3</sup>	0.5	N.D.	<1
Weak Acid Dissociable Cyanide	g/m <sup>3</sup>	0	N.D.	0.0005 - 0.0035

N.D: Not analysed – only required biennially.

## Landfill Groundwater Monitoring, Continued

### Bore A22 monitoring results

The table below shows the averages of results from samples collected from bore A22 during 2011 and 2012. Bore A22 is located west of the landfill.

Analyte	Units	2011 Average	2012 Average	Range (since Commissioning)
Temperature	°C	9.4	NR	8.6 - 12.1
pH		4.85	5.0	4.2 - 7.3
Conductivity	µS/cm	566	555	354 - 1204
Alkalinity	g/m <sup>3</sup>	7	10	1 - 294
Carbonaceous BOD5	g/m <sup>3</sup>	8	6	<1 - 15
Total Nitrogen	g/m <sup>3</sup>	6.8	6.85	0.42 - 8.1
Total Ammoniacal Nitrogen	g/m <sup>3</sup>	1.46	1.61	0.01 - 2.3
Fluoride	g/m <sup>3</sup>	2.6	3.1	0.03 - 3.2
Sulphate	g/m <sup>3</sup>	3	3	0 - 165
Total Iron	g/m <sup>3</sup>	1.55	1.995	0.59 - 3.45
Total Petroleum Hydrocarbons	g/m <sup>3</sup>	0.5	N.D.	<1 - 3.45
Total Kjeldahl Nitrogen	g/m <sup>3</sup>	6.7	6.8	0.9 - 8
Nitrate Nitrogen	g/m <sup>3</sup>	0.089	N.D.	<0.02 - 0.2
Nitrite Nitrogen	g/m <sup>3</sup>	0.006	N.D.	<0.002 - 0.13
Weak Acid Dissociable Cyanide	g/m <sup>3</sup>	<0.001	N.D.	<0.001 - 0.1
Boron	g/m <sup>3</sup>	0.041	N.D.	0.006 - 0.066
Manganese	g/m <sup>3</sup>	0.0156	N.D.	0.0049 - 0.394
Nickel	g/m <sup>3</sup>	0.0023	N.D.	0.0007 - 0.01
Potassium	g/m <sup>3</sup>	4.8	N.D.	1.65 - 5.3
Vanadium	g/m <sup>3</sup>	0.005	N.D.	0.002 - 0.022

N.D: Not analysed – only required biennially.

## Landfill Groundwater Monitoring, Continued

### Bore A23 monitoring results

The table below shows a summary of results from samples collected from bore A23 during 2011 and 2012. Bore A23 is located west of the landfill.

Analyte	Units	2011 Average	2012 Average	Range (since Commissioning)
Temperature	°C	10.2	N.D.	9 - 12.5
pH		5.75	5.85	5.4 - 6.4
Conductivity	µS/cm	489	472	378 - 745
Alkalinity	g/m <sup>3</sup>	30	32	31 - 60
Carbonaceous BOD5	g/m <sup>3</sup>	1.25	1	<1 - 5
Total Nitrogen	g/m <sup>3</sup>	1.85	1.835	0.88 - 2.7
Total Ammoniacal Nitrogen	g/m <sup>3</sup>	0.9	0.94	0.05 - 1.4
Fluoride	g/m <sup>3</sup>	<0.1	0.1	<0.1 - 0.36
Sulphate	g/m <sup>3</sup>	2.5	0.25	0.25 - 30
Total Iron	g/m <sup>3</sup>	4.8	5	2.6 - 13
Total Petroleum Hydrocarbons	g/m <sup>3</sup>	0.5	N.D.	<1 - 7.2
Total Kjeldahl Nitrogen	g/m <sup>3</sup>	1.8	1.815	1.1 - 2.3
Nitrate Nitrogen	g/m <sup>3</sup>	0.01	N.D.	<0.02 - 0.05
Nitrite Nitrogen	g/m <sup>3</sup>	0.01	N.D.	<0.02 - 0.019
Weak Acid Dissociable Cyanide	g/m <sup>3</sup>	<0.001	N.D.	<0.001 - 0.1
Boron	g/m <sup>3</sup>	0.05	N.D.	0.04 - 0.05
Manganese	g/m <sup>3</sup>	0.05	N.D.	0.05 - 0.12
Nickel	g/m <sup>3</sup>	0.0014	N.D.	<0.0005 - 0.0016
Potassium	g/m <sup>3</sup>	4	N.D.	4 - 5
Vanadium	g/m <sup>3</sup>	0.0091	N.D.	0.013 - 0.021

N.D: Not analysed – only required biennially.

## Landfill Groundwater Monitoring, Continued

### Bore A24 monitoring results

The table below shows a summary of results from samples collected from bore A24 during 2011 and 2012. Bore A24 is located south east of the landfill.

Analyte	Units	2011 Average	2012 Average	Range (since Commissioning)
Temperature	°C	10	N.D.	9.4 - 12.8
pH		8.5	8.5	6.9 - 8.7
Conductivity	µS/cm	4595	4140	447 - 7290
Alkalinity	g/m <sup>3</sup>	1703	904	414 - 2600
Carbonaceous BOD5	g/m <sup>3</sup>	70	64	2 - 120
Total Nitrogen	g/m <sup>3</sup>	285	233	16.8 - 560
Total Ammoniacal Nitrogen	g/m <sup>3</sup>	233	188	28.2 - 450
Fluoride	g/m <sup>3</sup>	91	93	<0.1 - 120
Sulphate	g/m <sup>3</sup>	39	22	0 - 312
Total Iron	g/m <sup>3</sup>	34	30	8.2 - 60
Naphthalene	mg/m <sup>3</sup>	212	59	0.06 - 510
Anthracene	mg/m <sup>3</sup>	0.60	0.195	<0.3 - 1.2
Phenanthrene	mg/m <sup>3</sup>	2.3	0.6	<0.3 - 4.9
Fluoranthene	mg/m <sup>3</sup>	0.68	0.1975	<0.3 - 1
Total Petroleum Hydrocarbons	g/m <sup>3</sup>	2	N.D.	<1 - 18.6
Total Kjeldahl Nitrogen	g/m <sup>3</sup>	285	255	63 - 560
Nitrate Nitrogen	g/m <sup>3</sup>	0.42	N.D.	0.05 - 33
Nitrite Nitrogen	g/m <sup>3</sup>	0.08	N.D.	0.01 - 1.3
Weak Acid Dissociable Cyanide	g/m <sup>3</sup>	0.005	N.D.	<0.01 - 0.1
Boron	g/m <sup>3</sup>	12.6	N.D.	4.1 - 17
Manganese	g/m <sup>3</sup>	0.136	N.D.	0.11 - 0.22
Nickel	g/m <sup>3</sup>	0.03	N.D.	0.004 - 0.05
Potassium	g/m <sup>3</sup>	56	N.D.	11 - 79
Vanadium	g/m <sup>3</sup>	1.62	N.D.	0.21 - 2.54

N.D: Not analysed – only required biennially.

## Landfill Groundwater Monitoring, Continued

### Bore A6 monitoring results

The table below shows a summary of results from samples collected from bore A6 during 2011 and 2012. Bore A6 is located south east of the landfill.

Analyte	Units	2011	2012	Range (since Commissioning)
		Average	Average	
Temperature	°C	11.5	N.D.	10.3 - 13.5
pH		6.9	6.8	5.8 - 7.6
Conductivity	µS/cm	2730	2625	158 - 5689
Alkalinity	g/m <sup>3</sup>	595	645	280 - 943
Carbonaceous BOD5	g/m <sup>3</sup>	3	3	1 - 6
Total Nitrogen	g/m <sup>3</sup>	23	20	9.7 - 47.4
Total Ammoniacal Nitrogen	g/m <sup>3</sup>	14	10	0.15 - 34.7
Fluoride	g/m <sup>3</sup>	50	60	2 - 104
Sulphate	g/m <sup>3</sup>	690	660	480 - 2050
Total Iron	g/m <sup>3</sup>	30	27	4.2 - 40
Naphthalene	mg/m <sup>3</sup>	<2	<2	<0.1 - 1
Anthracene	mg/m <sup>3</sup>	<0.4	<0.4	0.05 - 1.34
Phenanthrene	mg/m <sup>3</sup>	<0.4	<0.4	<0.05 - 0.2
Fluoranthene	mg/m <sup>3</sup>	<0.4	<0.4	<0.01 - 0.2
Total Petroleum Hydrocarbons	g/m <sup>3</sup>	0.5	N.D.	<1 - 9.2
Total Kjeldahl Nitrogen	g/m <sup>3</sup>	23	20	14.2 - 48
Nitrate Nitrogen	g/m <sup>3</sup>	0.114	N.D.	0.001 - 14
Nitrite Nitrogen	g/m <sup>3</sup>	0.039	N.D.	0.004 - 0.218
Weak Acid Dissociable Cyanide	g/m <sup>3</sup>	0.0027	N.D.	0.0018 - 0.1
Boron	g/m <sup>3</sup>	0.79	N.D.	0.66 - 2.54
Manganese	g/m <sup>3</sup>	1.5	N.D.	0.22 - 1.85
Nickel	g/m <sup>3</sup>	0.0056	N.D.	0.005 - 0.022
Potassium	g/m <sup>3</sup>	14	N.D.	14 - 37
Vanadium	g/m <sup>3</sup>	0.18	N.D.	0.05 - 0.4

N.D: Not analysed – only required biennially.

## Landfill Groundwater Monitoring, Continued

### Bore T1A monitoring results

The table below shows a summary of results from samples collected from bore T1A in 2011 and 2012. Bore T1A is located south east of the Haysoms DWP area.

Analyte	Units	2011 Average	2012 Average	Range (since Commissioning)
pH	-	8.85	8.9	6.8 - 9.6
Alkalinity	g/m <sup>3</sup>	535	333.5	108 - 2110
Temperature	°C	11.2	N.D.	10.6 - 13.7
Conductivity	µS/cm	2258	1416	473 - 8930
Carbonaceous BOD <sub>5</sub>	g/m <sup>3</sup>	2	1	<1 - 10
Fluoride	g/m <sup>3</sup>	84	31	<0.1 - 210
Sulphate	g/m <sup>3</sup>	50	26	17.4 - 338
Total Iron	g/m <sup>3</sup>	0.665	0.20	0.01 - 15.3
Boron	g/m <sup>3</sup>	3.9	N.D.	0.05 - 12.6
Manganese	g/m <sup>3</sup>	0.06	N.D.	0.0006 - 0.253
Potassium	g/m <sup>3</sup>	10	N.D.	2.44 - 69.1
Vanadium	g/m <sup>3</sup>	0.11	N.D.	<0.01 - 0.34
Nickel	g/m <sup>3</sup>	<0.01	N.D.	<0.0005 - 0.044
Ammoniacal-Nitrogen	g/m <sup>3</sup>	68	31.55	<0.01 - 580
Total Nitrogen	g/m <sup>3</sup>	142	89	1.5 - 783
Total Kjeldahl Nitrogen	g/m <sup>3</sup>	77	33	0.4 - 630
Nitrate Nitrogen	g/m <sup>3</sup>	27.62	N.D.	1.25 - 229
Nitrite Nitrogen	g/m <sup>3</sup>	1.38	N.D.	0.003 - 20.8
Total Petroleum Hydrocarbons	g/m <sup>3</sup>	0.5	N.D.	<1
Weak Acid Dissociable Cyanide	g/m <sup>3</sup>	0.01	N.D.	<0.001 - 0.325

N.D: Not analysed – only required biennially.

## Landfill Groundwater Monitoring, Continued

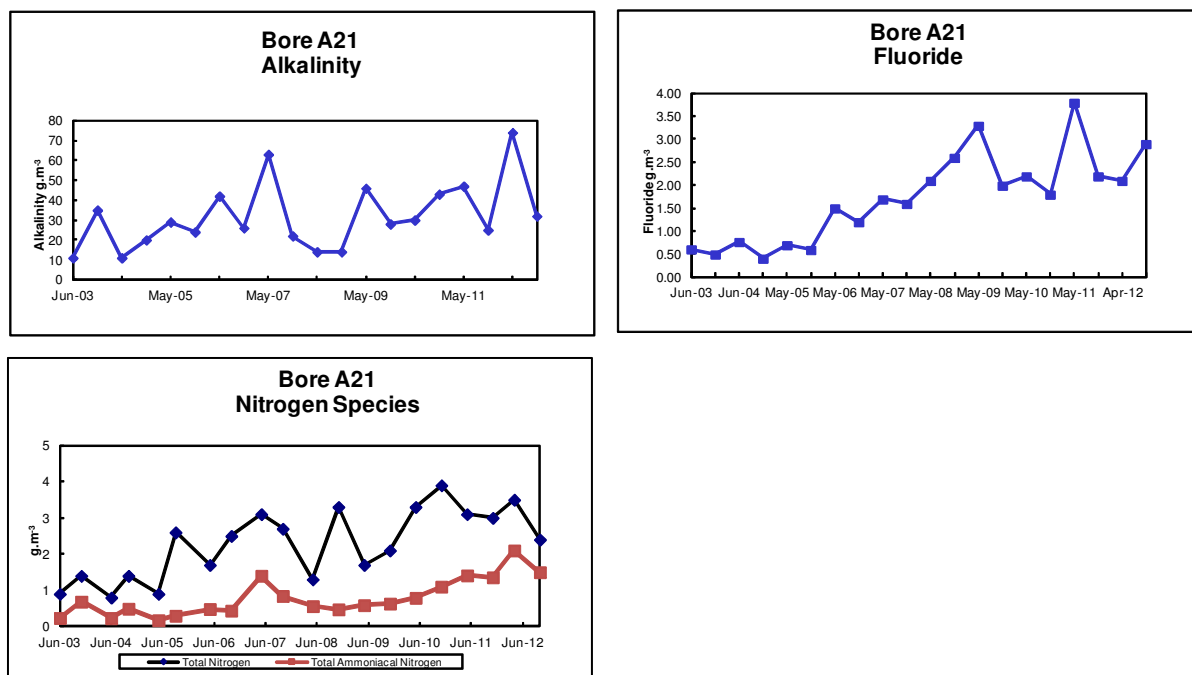
### Comments

Three of the Landfill bores, A21, A41 and A22, showed variations in analyte concentrations during the two surveys carried out in 2012. The 1<sup>st</sup> survey was carried out in April 2012 and the 2<sup>nd</sup> in November 2012.

Shown below are the bores, which showed significant changes or trends in analyte concentrations in 2012.

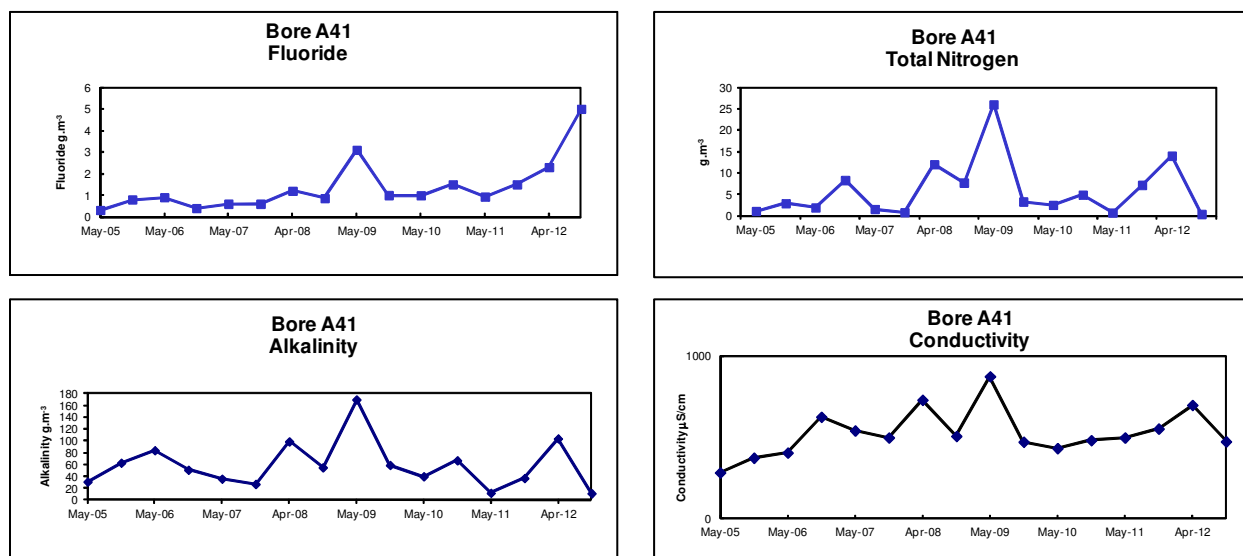
#### Bore A21

Bore A21 is upstream of the landfill but appears to be showing minor leachate influence.



#### Bore A41

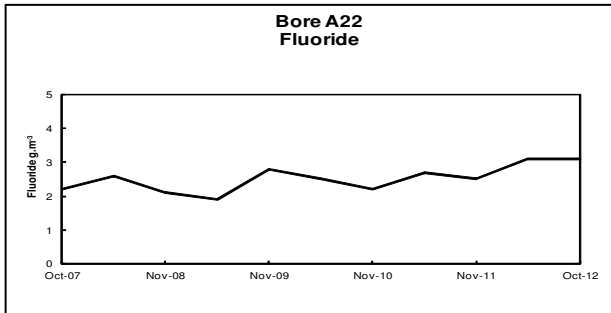
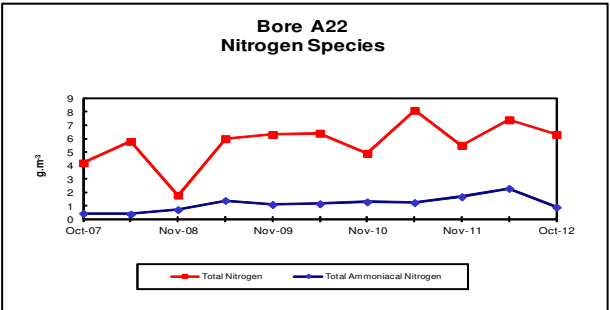
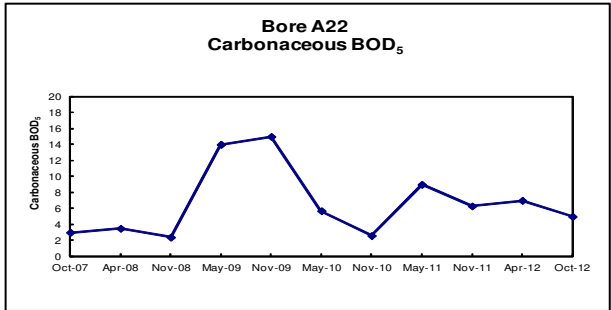
Bore A41 is upstream of the Haysoms DWP but appears to be showing minor leachate influence.



# Landfill Groundwater Monitoring, Continued

## Bore A22

Bore A22 is to the west side of the landfill and will monitor any leachate from the general tipping area moving in this direction. This bore is also showing minor leachate influence.





## **Part L - Groundwater**

### **Spent Cathode Pad Leachate**

Monitoring of the groundwater during 2011 showed a spike in some levels of contaminants in several of the shallow bores close to the pad. Increased monitoring, during 2012, showed a decrease in concentrations to pre 2011 levels.

### **Spent Cell Lining Storage Shed**

Monitoring of the membranes under the Spent Cell Lining storage shed continued during 2012. The concentration of fluoride and cyanide in the liquid between the membranes has not changed significantly.

Monitoring of the groundwater around the shed showed that the concentrations of cyanide and fluoride in the groundwater have not changed significantly.

## Part M - Greenhouse Gas Discharges

### Calculated Carbon Dioxide and Perfluorocarbon Discharges

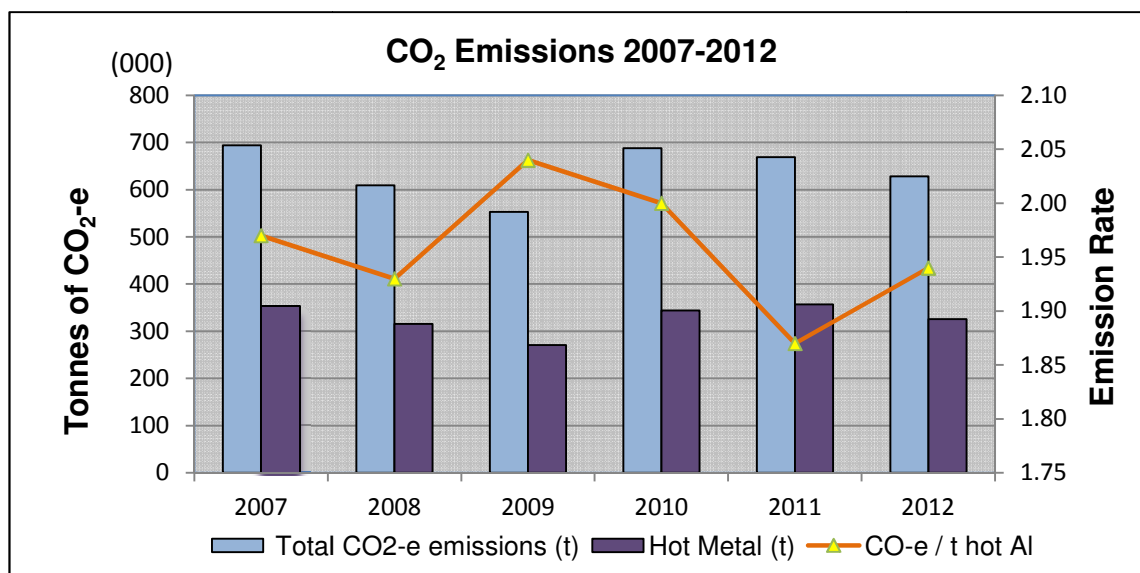
#### Introduction

Air discharge permit 203378 does not have a requirement to report calculated carbon dioxide and perfluorocarbon discharges from NZAS during each calendar year; however NZAS will continue to report this for general information purposes.

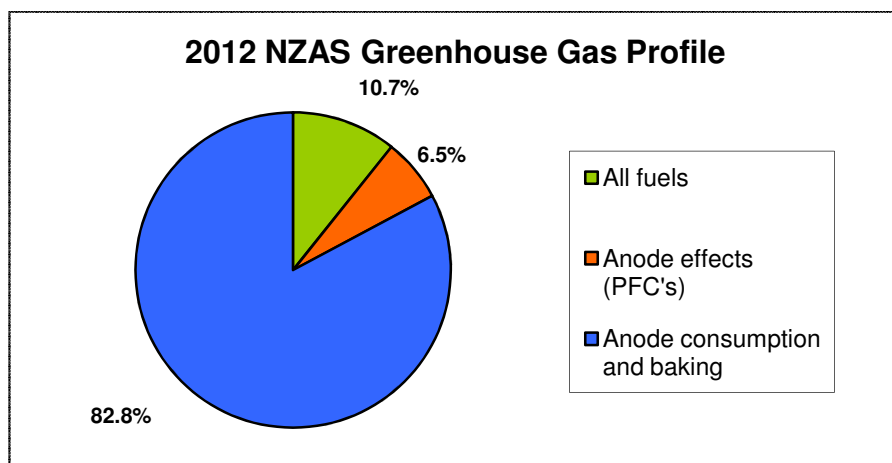
NZAS had a year with reduced metal production due to ongoing financial difficulties. Line 4 was shot down for most of the year and further cells cut out on other production lines.

#### Carbon Dioxide - 2012

The total calculated carbon dioxide equivalent (CO<sub>2</sub>-e) discharge from NZAS during the year ending 31 December 2012 was 628,456 tonnes. 40,418 tonnes less CO<sub>2</sub>-e than last year and with metal production decreased by 32,143 tonnes. The emission rate in 2012 was 1.94 t CO<sub>2</sub>-e / per tonne of aluminium produced, which is similar to results achieved in 2008.



The total calculated CO<sub>2</sub> equivalents are emitted from carbon consumption (anodes), perfluorocarbons generation (PFCs) and fuel usage.



## **Greenhouse Gas Discharges, Continued**

### **Anodes – 2012**

83% of the total CO<sub>2</sub> emissions from the smelter are due to baking and consuming carbon anodes. Emission of greenhouse gases during the production of aluminium is unavoidable as the consumption of carbon anode blocks form part of the chemical process to produce aluminium. However emissions can be minimised by manufacturing high quality anodes and ensure that they are not burning when in contact with air in the cells (airburn). A very low rate of airburn was observed during 2012, which kept the anode consumption at a favourable level.

### **Perfluorocarbons – 2012**

Perfluorocarbons (PFCs) contribute to climate change in the same way that CO<sub>2</sub> does. PFCs are gases emitted from the aluminium production process when conditions in the cells become unstable. The total calculated PFCs discharged from NZAS during 2012 increased by 34% compared to a record performance in 2011. Cells were cut out to curtail production and causing instability which in effect can cause higher levels of PFCs. The percentage of PFC's emitted as CO<sub>2</sub> equivalent out of the total greenhouse gas emission was 6.5%.

### **Fuel - 2012**

Heavy fuel oil is the main fuel used on site and is used for baking the carbon anodes and heating of some casting furnaces. Calculated CO<sub>2</sub> equivalents from fuels increased slightly during 2012. The rebuild of carbon baking furnace 4 was undertaken during 2012. The greenhouse gas contribution from fuels is stable at about 10% of the total emissions.

End of Report for 2012

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