



New Zealand Aluminium Smelters Limited

**Interdepartmental
Committee
Annual Report
2013**

*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 2013*

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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 2013.

Main Stack

Main Stack discharges to air were within permit standards during 2013.

Potline Roof Louvres

Potline roof louvre discharges were within permit standards during 2013.

Dust Collector Discharges

Eleven dust collectors were tested during 2013. All dust collectors tested during 2013 were within permits standards.

Dispersion

Wind speeds and direction were generally similar to previous years.

Monthly rainfall for 2013 was variable with the annual total of 1183mm being slightly above the 5 year running average of 1049mm.

Ambient Air

All sites were within permit standards.

Atmospheric Deposition

All permit guidelines were met during 2013.

Vegetation

The fluoride concentrations of ungrazed grass sites during 2013 were similar to the concentrations measured in previous years.

Fluoride in *Pinus radiata* needles were within permit guidelines during 2013.

The fluoride concentrations of grazed grass for all monitoring farms were within permit standards during 2013 and similar to previous years. Cattle urine on GMF4 during 2013 was within the guideline.

Water Take

Water take from the aquifer was within permit standards for 2013.

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 2013.

All permit standards were met for Treated Sewage discharges during 2013.

Groundwater monitoring results from the sewage monitoring bores showed an increase in Phosphorous concentration during 2013. The concentrations of nitrogen species has remained stable in these bore indicating it is probably not being affected by the sewage discharge.

Groundwater

Groundwater monitoring around the SCL storage shed and underneath the storage shed showed no significant changes of analytes during 2013. The cathode pad stockpile groundwater showed no significant changes of analytes during 2013.

Landfill

Monitoring of groundwater near the NZAS landfill during 2013 showed some minor leachate influence in some of the upstream bores monitored.

Greenhouse Gas Discharges

There was a slight increase in absolute carbon dioxide emissions during 2013. The emission rate in 2013 was 2.00 t CO₂-e / per tonne of aluminium produced.

Part A - Environmental Management

Introduction

This report summarises NZAS' environmental performance during 2013 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 team provides much of the data within this report. A comprehensive auditing programme conducted by Environment Southland verifies the validity of this data.

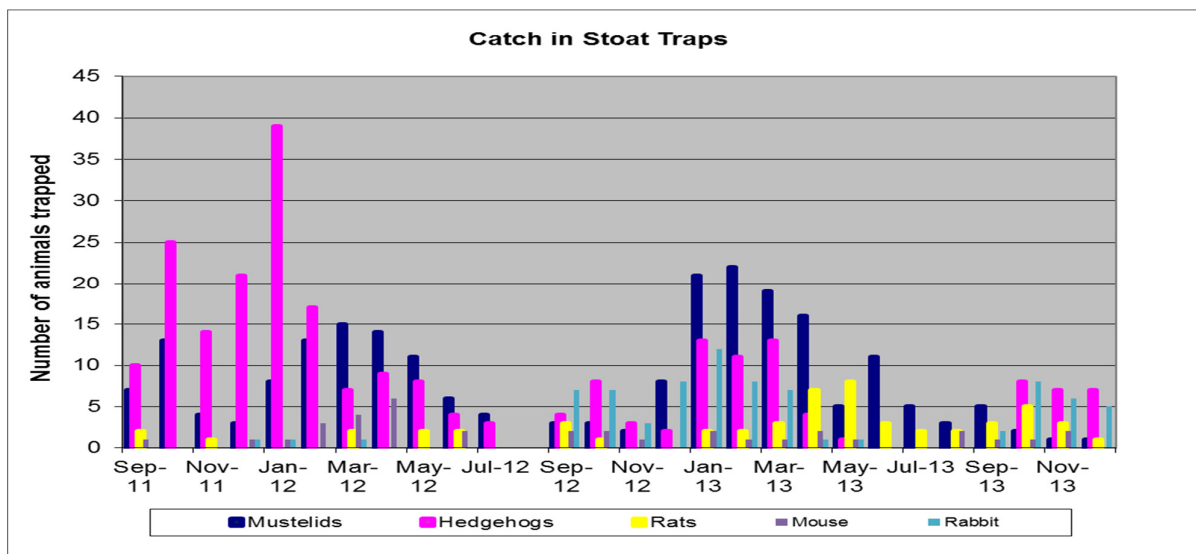
NZAS' Laboratory has maintained accreditation to NZS/ISO/IEC 17025 "General Competence of Calibration and Testing Laboratories". The scope of the accreditation includes Quality Systems to ensure the accuracy of data. Where samples are forwarded to external laboratories for analysis, these laboratories have accreditation to NZS/ISO/IEC 17025

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 constraints the stoat trapping project is now run with the help of volunteers from NZAS, DOC and the wider community. Volunteers have run this programme since September 2012. The catch from the monthly checking of traps is displayed in the graph below.



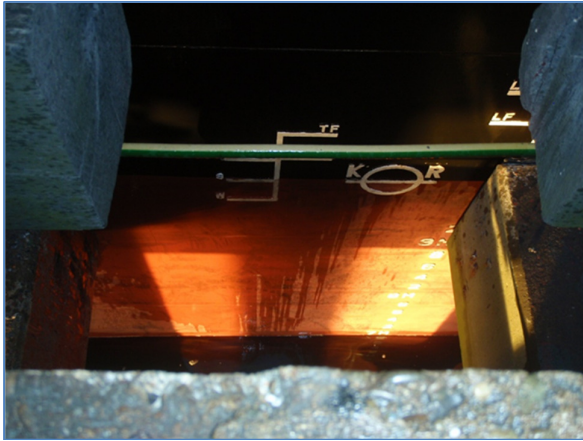
Environmental Incidents

Incidents Involving Consent Violations

There were two environment incidents reported to Environment Southland over 2013.

Hydraulic Oil Spill from Ship Unloader at Wharf – 26 March 2013

Due to the failure of a hose fitting, approximately 5 litres of hydraulic oil was released from the ship unloader into the sea when discharging alumina. Oil was also spilt on the wharf, ship unloader, the ship's deck and side. Approximately 40 litres was lost in this incident.



Another type of hose fitting was fitted to prevent this from happening again as it was identified that the original fitting was not best choice for the task.

Alumina Spill at Wharf – 1 November 2013

Environment Southland received a complaint from a concerned Bluff resident of a large plume coming from the Tiwai wharf.

Approximately 110kg of alumina was discharged into the sea and air when a hatch was removed to repair a scraper chain on the alumina conveyor belt. The belt had not been cleaned prior to maintainers opening up the hatch for repair. Modifications to the design of the hatch was been carried out to reduce the risk of alumina spilling when working on the hatch. Checks put in place to ensure the hatch has been cleaned prior to maintaining the equipment.



Reported Incidents

Alumina Dust from Discharge of MV Nord Tokyo on 28th October

Environment Southland received a complaint from a concerned Bluff resident of fugitive dust emissions coming from the discharge of a boat at the Tiwai wharf.

This complaint occurred during a period of variable wind speeds and direction during unloading of alumina at the wharf. Immediately prior to the complaint being received, NZAS staff has identified increasing excessive fugitive alumina dust emanating from the ship's hold and had implemented procedures to minimise these emissions.

Audit Programme

Auditing conducted by Environment Southland (ES) during 2013 included:

Audit Sample Type		Sites	Date	Issues
Ambient Air	1 km Hut	1	February May	None None
	Bluff	1	November	None
Vegetation		16	October	None
Atmospheric Deposition		2	February	None
		2	July	None
Drains	North	3	September	None
	South	3	September	None
	West	3	September	None
Treated Effluent		1	May, December	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 2016 in agreement with Environment Southland to allow additional time for determining and costing the scope of the work.

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 6th 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 2013.

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

Parameter	Units	Running 12 month average	
		Permit Limit	2013
Gas flow rate	Sm ³ / min	-	60,200
Total particulate	kg/min	1.70	0.31
Gaseous fluoride	kg/min	0.50	0.19
Particulate fluoride	kg/min	0.20	0.01
Sulphur dioxide	kg/min	21.4	12.8
Total condensable hydrocarbons	kg/min	-	0.04
Polycyclic aromatic hydrocarbons	kg/min	-	0.003

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.

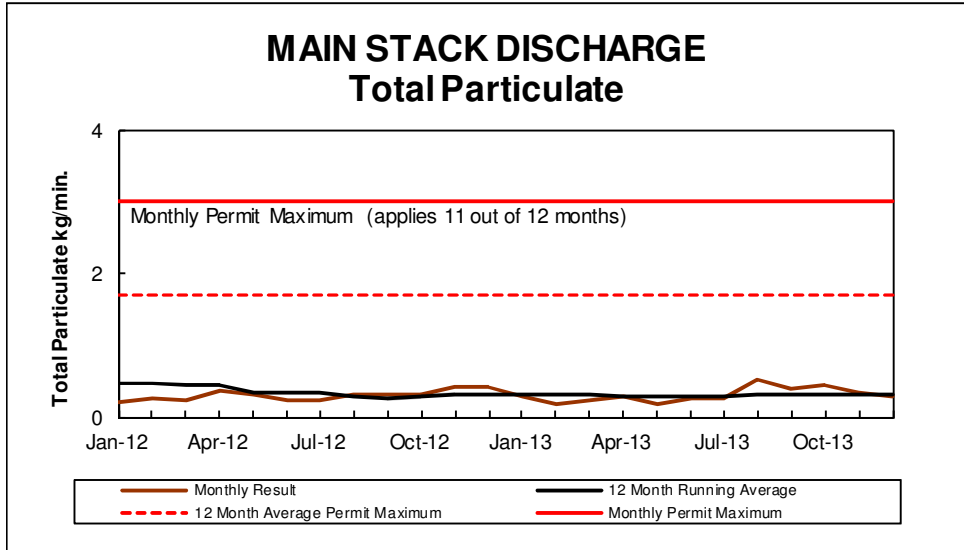
Parameter	Units	Monthly Results		
		Limit applies 11 out of 12 Months		
		Permit Limit	Maximum	Number of times > Limit
Total particulate	kg/min	3.00	0.52	0
Gaseous fluoride	kg/min	0.65	0.28	0
Sulphur dioxide	kg/min	23.0	15.3	0

Main Stack Discharges, continued

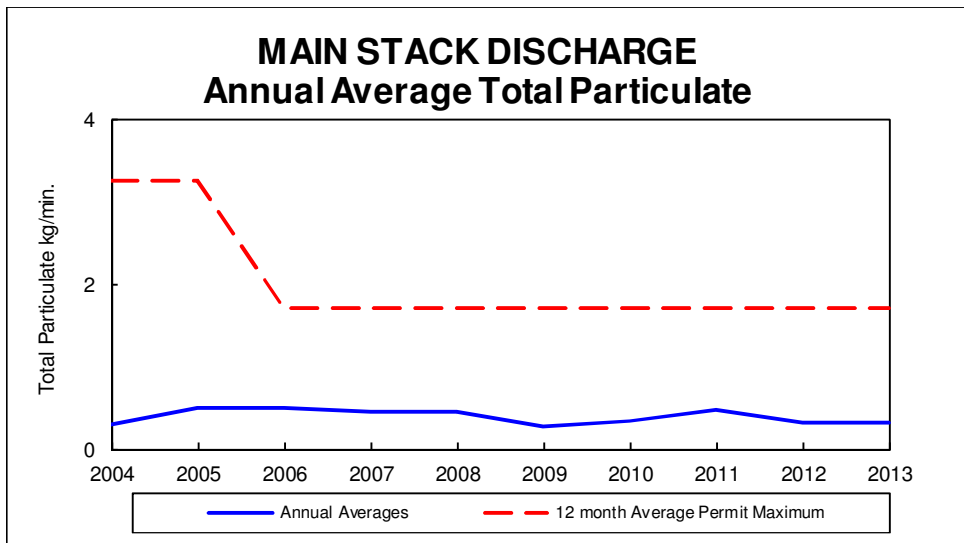
Total particulate

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 2012 and 2013.



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

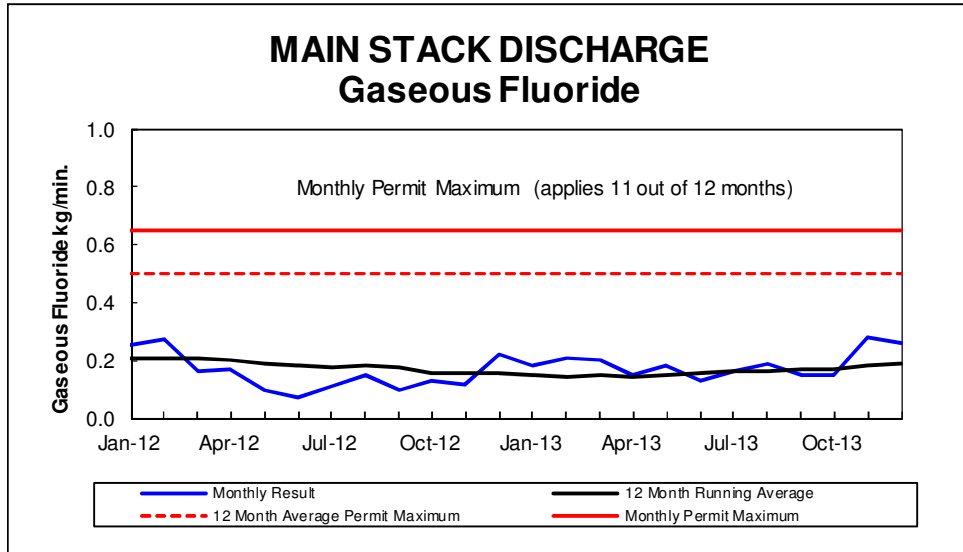


Main Stack Discharges, continued

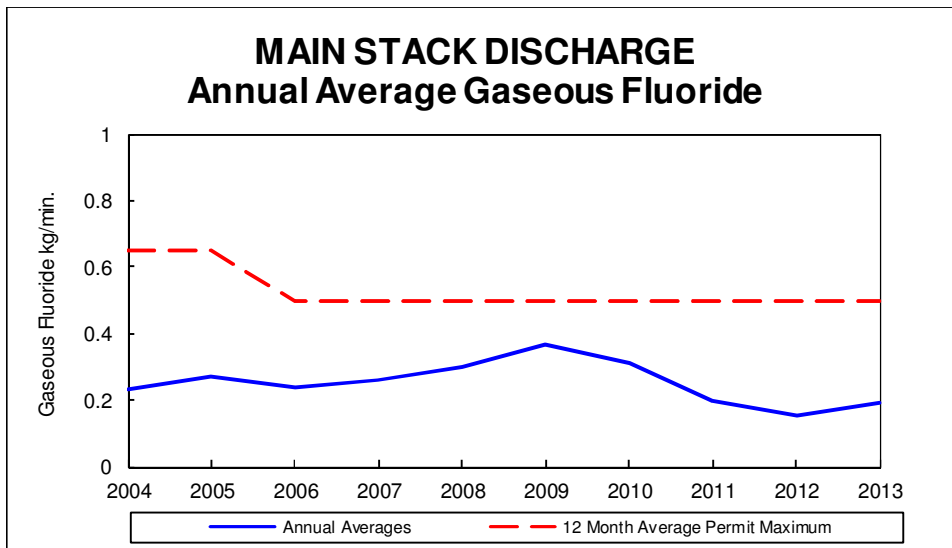
Gaseous fluoride

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 2012 and 2013.



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

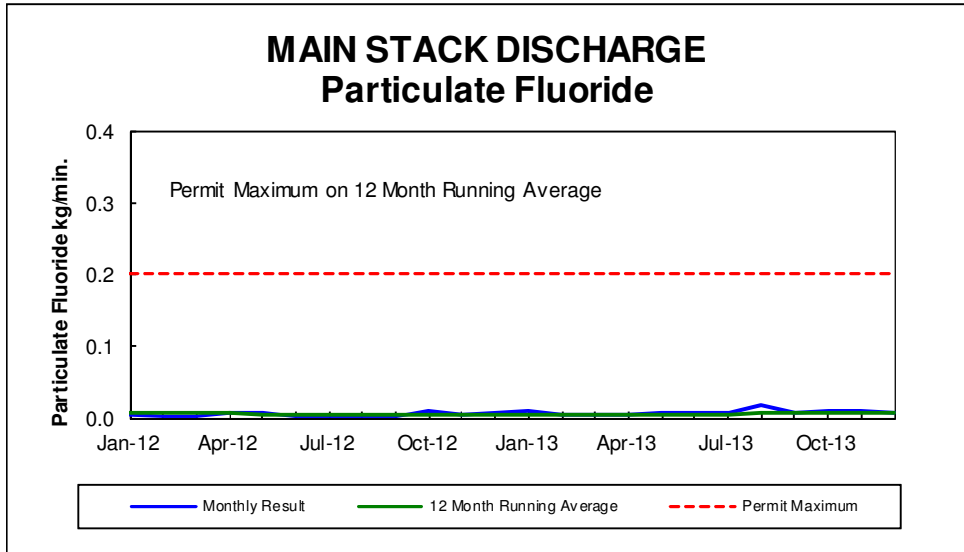


Main Stack Discharges, continued

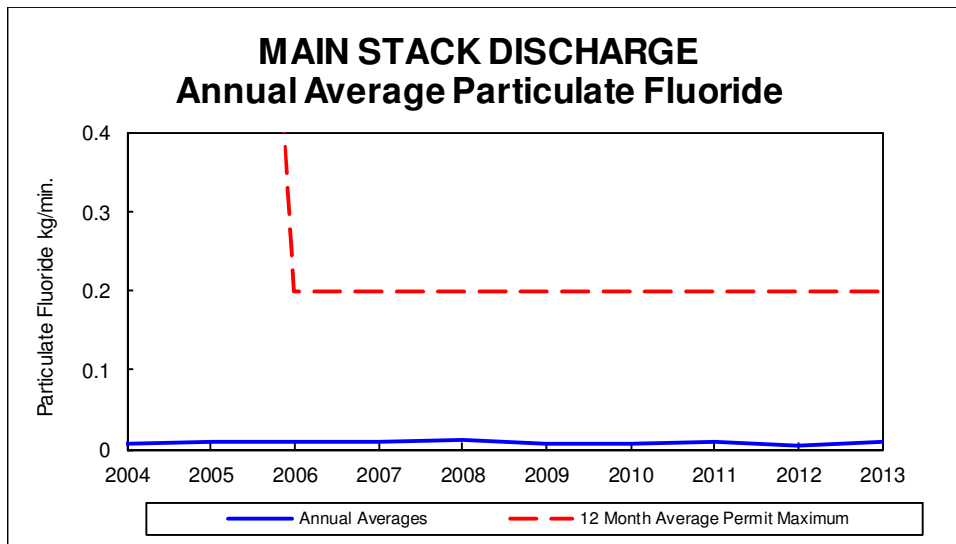
Particulate fluoride

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 2012 and 2013.



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

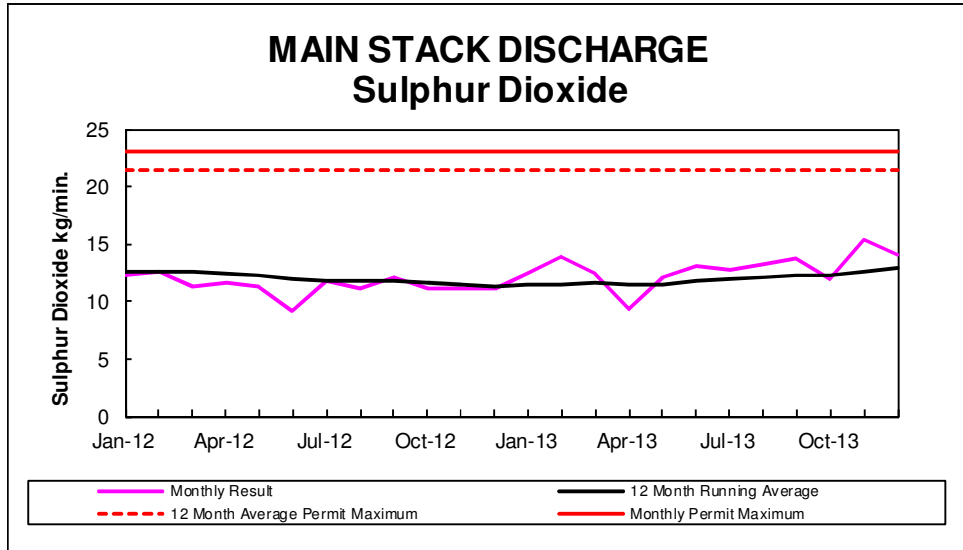


Main Stack Discharges, continued

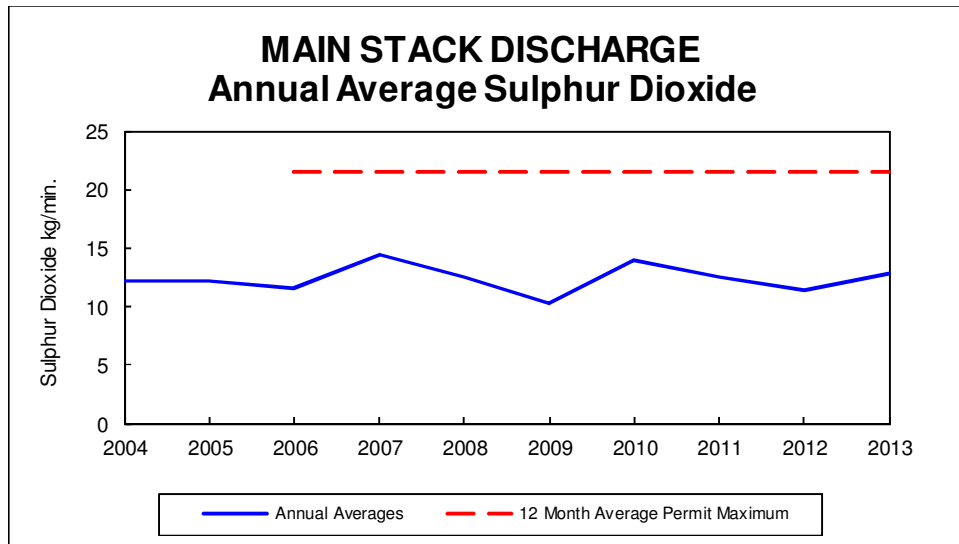
Sulphur Dioxide

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.



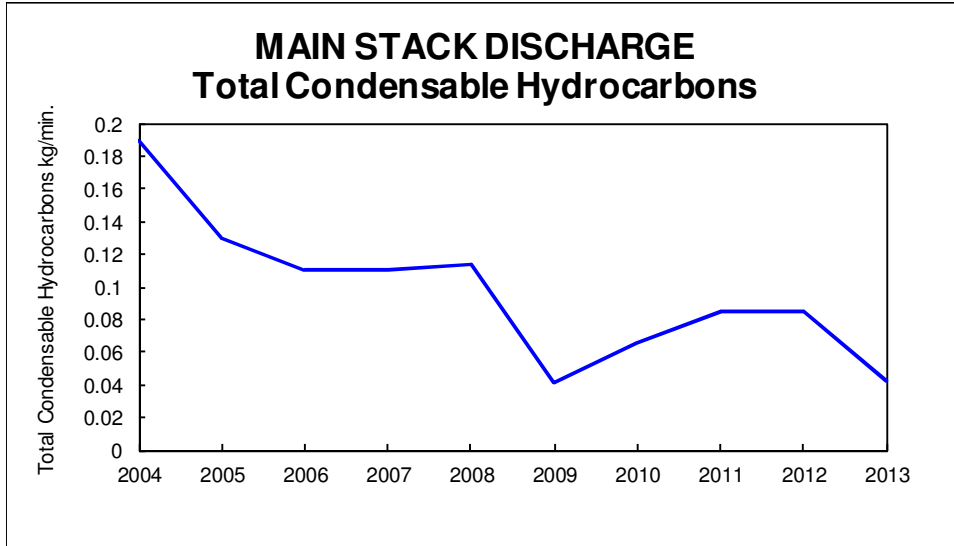
The following graph shows the annual average main stack sulphur dioxide discharge.



Main Stack Discharges, continued

Total Condensable Hydrocarbons and Polycyclic Aromatic Hydrocarbons

The annual analysis for total condensable hydrocarbons and 16 USEPA priority PAH was carried out in April 2013. The following graph shows the annual Total Condensable Hydrocarbons discharges. This annual analysis was not carried out during 2012 due to the financial constraints. 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 2013.

The reported 12 month running average emissions showed a slight increase or were similar in 2013 to 2012. Operational difficulties with the dry scrubbing system during the last quarter contributed to this increase.

Potline Roof Louvre Discharges

Monitoring results

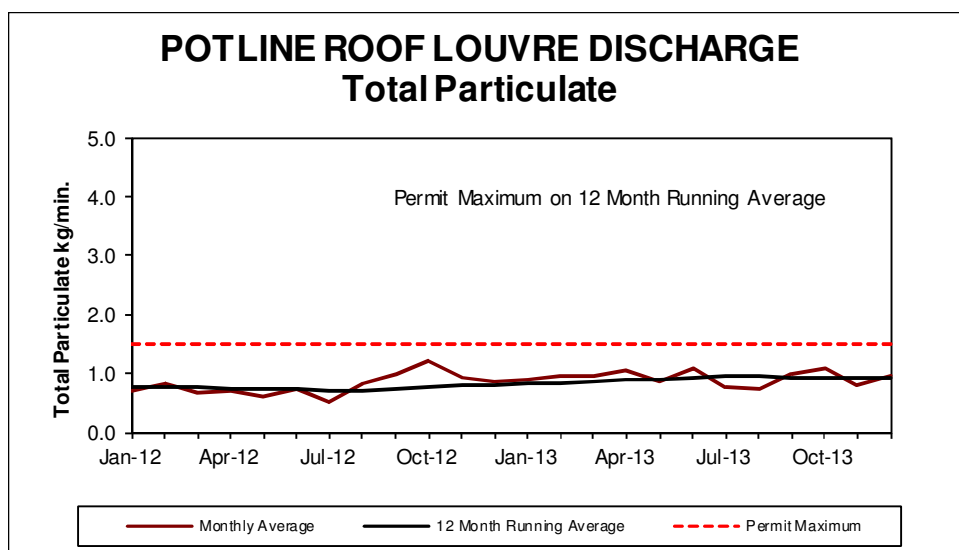
The table below shows the Potline roof louvre monitoring results for 2013. The permit limits are for 12 month running averages. There is no permit limit on maximum emissions in any given month.

Parameter	Units	Running 12 month average		
		Permit Limit	2013	Maximum for any month
Total particulate	kg/min	1.50	0.92	1.08
Gaseous fluoride	kg/min	0.21	0.09	0.14
Particulate fluoride	kg/min	0.30	0.13	0.16
Sulphur dioxide	kg/min	0.55	0.18	0.22

Total particulate

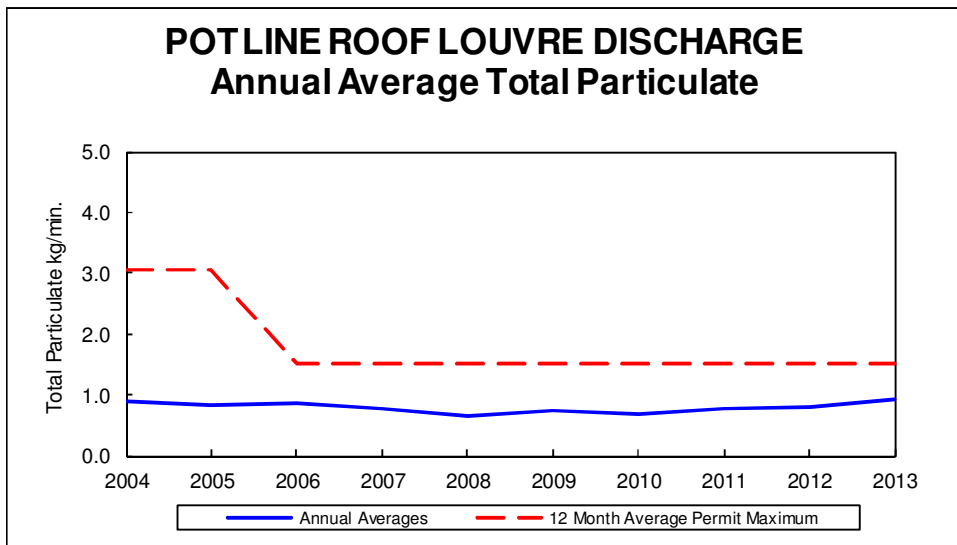
Permit: 12 month running average not to exceed 1.50 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre total particulate discharge during 2012 and 2013.



Potline Roof Louvre Discharges, continued

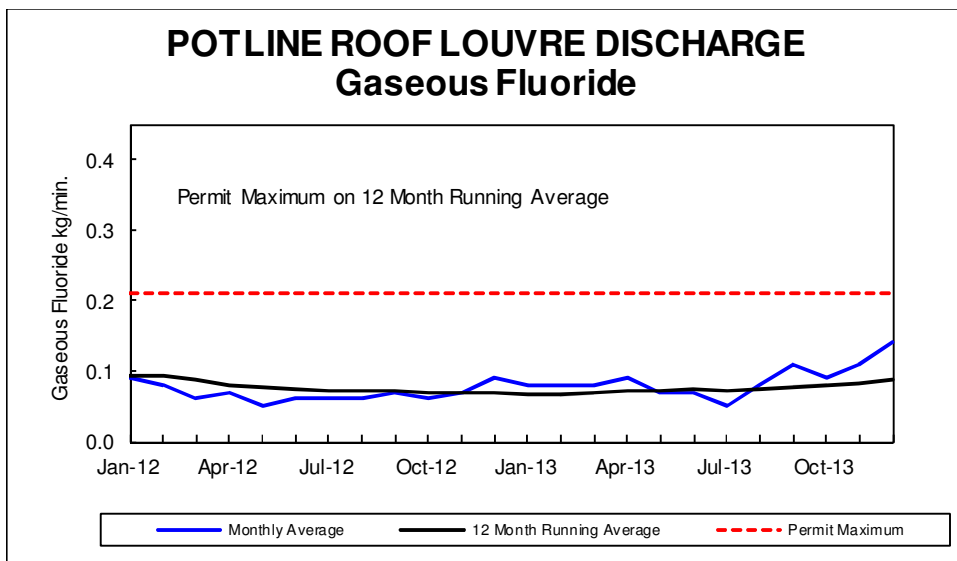
The following graph shows the annual average Potline roof louvre total particulate discharge.



Gaseous fluoride

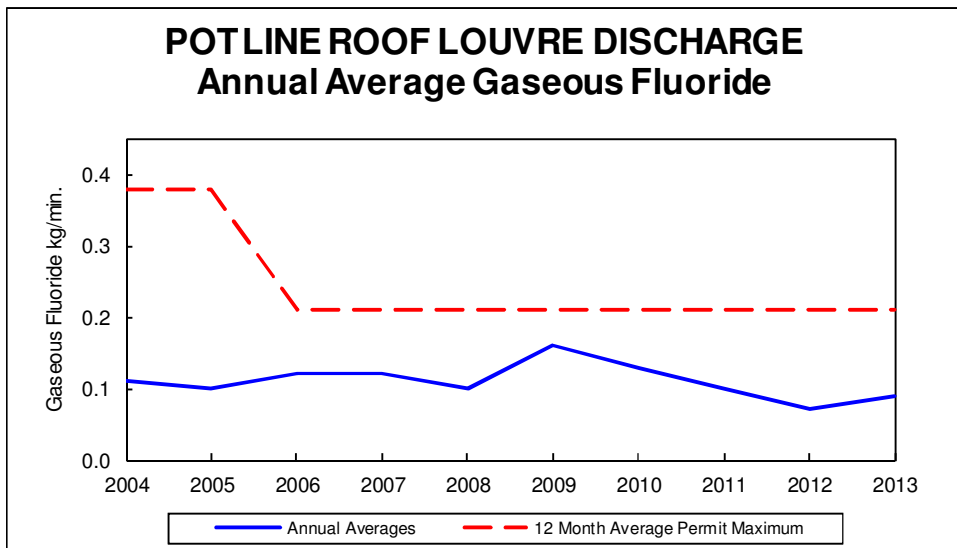
Permit: 12 month running average not to exceed 0.21 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre gaseous fluoride discharge during 2012 and 2013.

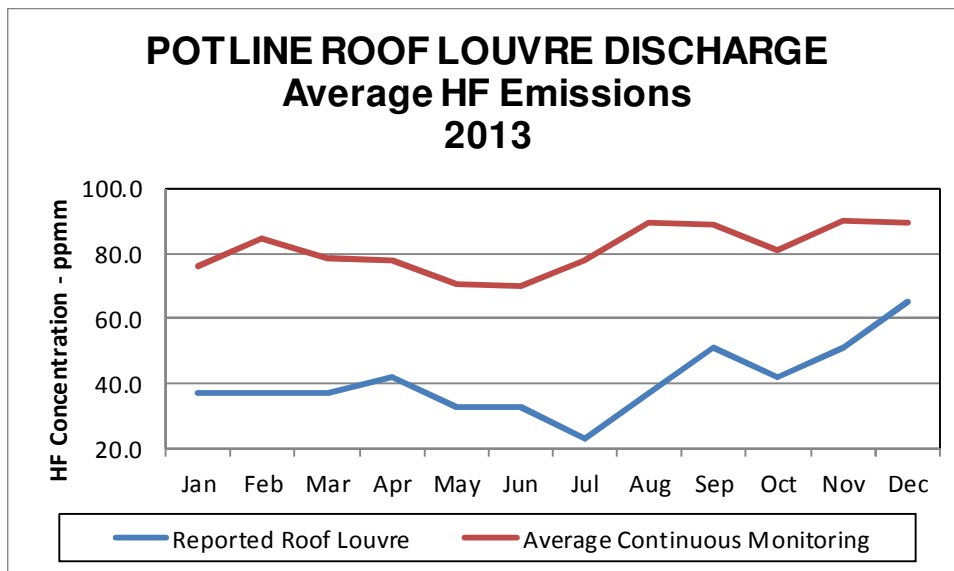


Potline Roof Louvre Discharges, continued

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.

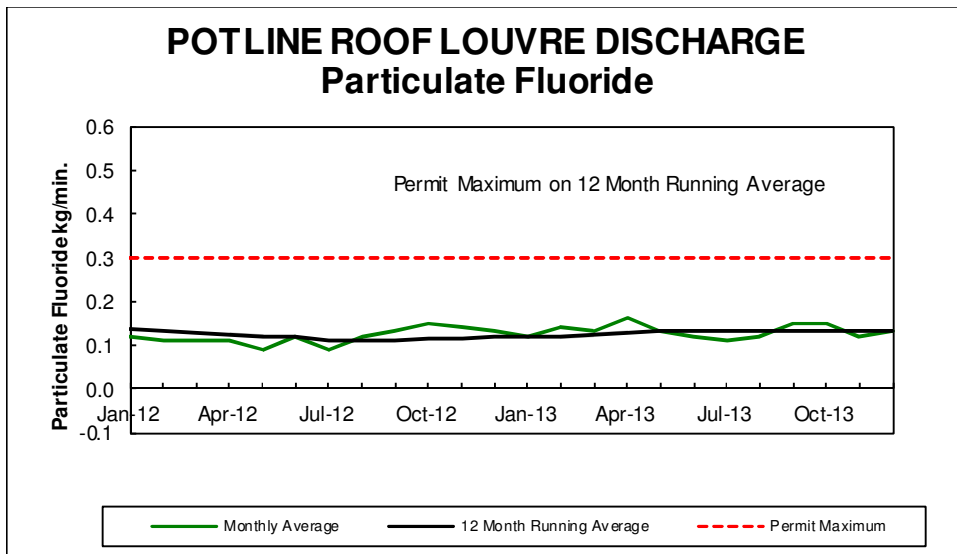


Potline Roof Louvre Discharges, continued

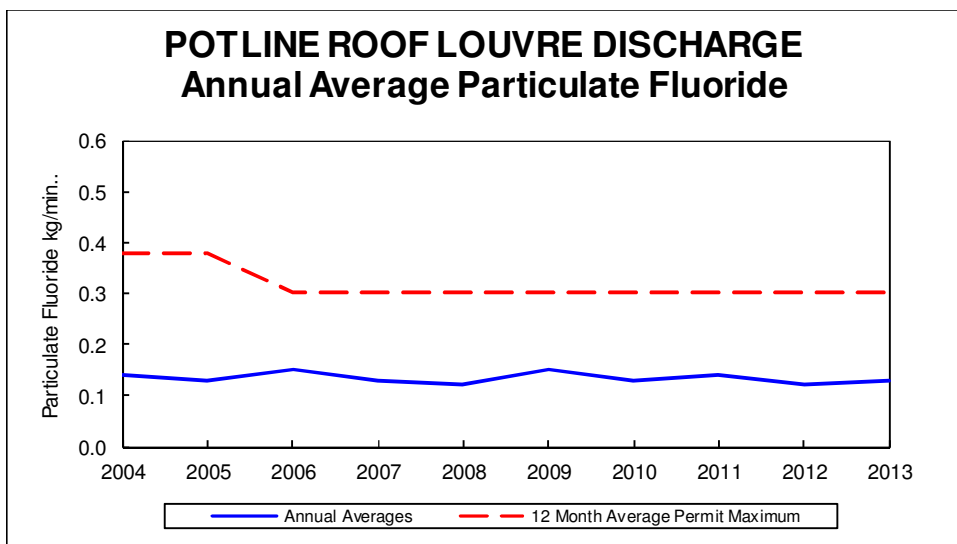
Particulate fluoride

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 2012 and 2013.



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

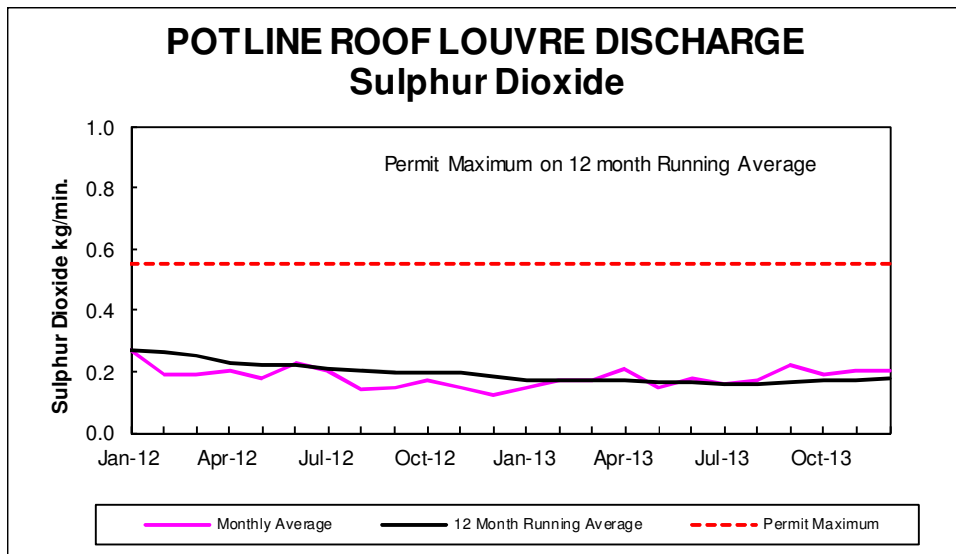


Potline Roof Louvre Discharges, continued

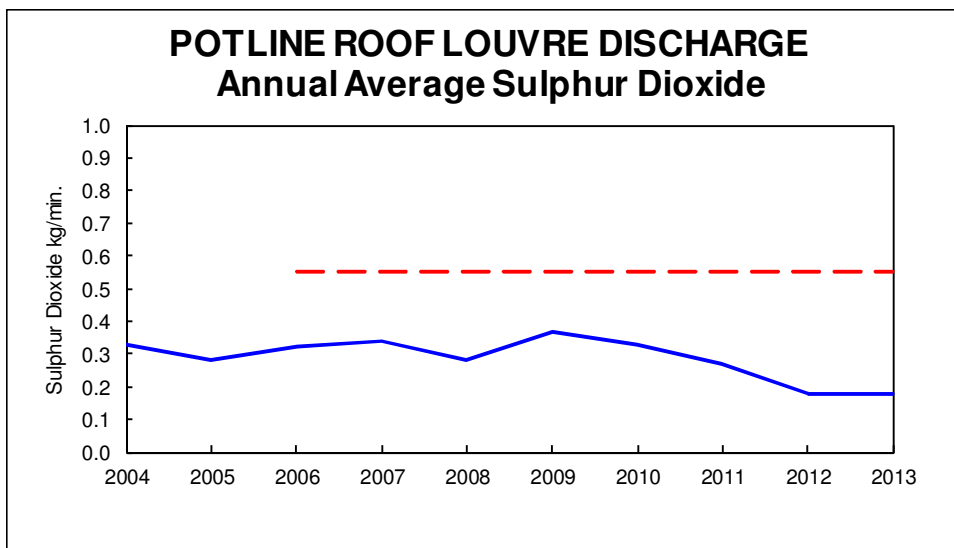
Sulphur dioxide

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 2012 and 2013.



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 785,917 Sm³/min to 720,800 Sm³/min.

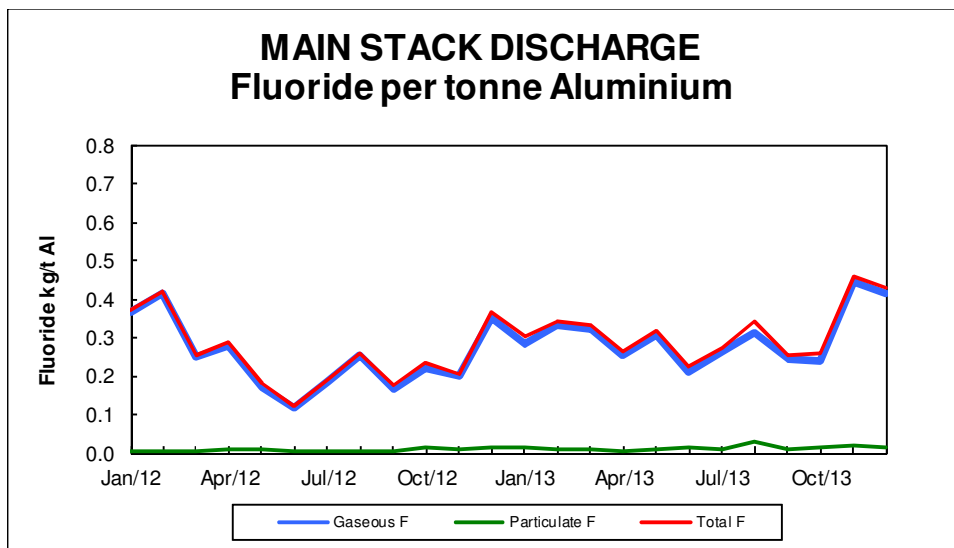
Fluoride Discharges

Performance data

The table below shows the fluoride discharges expressed as a ratio of hot aluminium metal production during 2013.

Parameter	Units	2013	Maximum for any month
Main Stack			
• Gaseous fluoride	kg/t Al	0.30	0.44
• Particulate fluoride	kg/t Al	0.01	0.03
• Total fluoride	kg/t Al	0.31	0.46
Reduction Line Roof Louvres			
• Gaseous fluoride	kg/t Al	0.14	0.22
• Particulate fluoride	kg/t Al	0.21	0.27
• Total fluoride	kg/t Al	0.35	0.43
Plant			
• Gaseous fluoride	kg/t Al	0.44	0.64
• Particulate fluoride	kg/t Al	0.22	0.28
• Total fluoride	kg/t Al	0.66	0.86

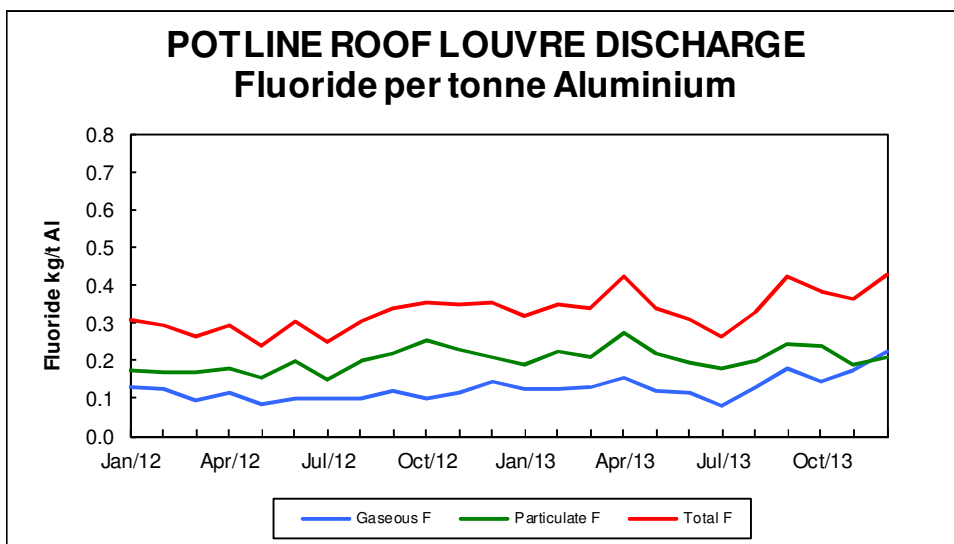
The following graph shows the monthly main stack fluoride per tonne aluminium discharge during 2012 and 2013.



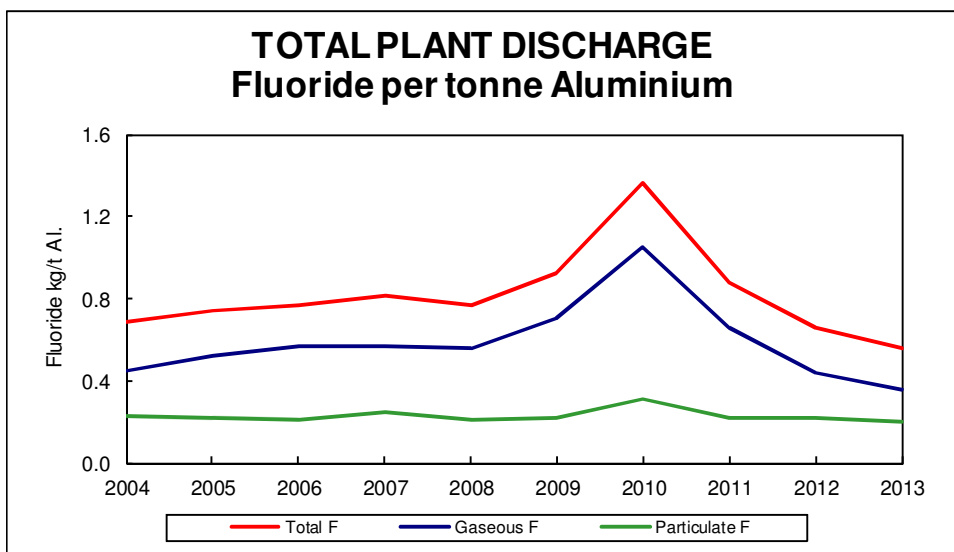
Fluoride Discharges, continued

Performance data, Continued

The following graph shows the average monthly Potline roof louvre fluoride per tonne aluminium discharge during 2012 and 2013.



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 2013.

Dust Collector Discharges

Permit Conditions:

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

Monitoring results

The table below shows the Dust Collector monitoring results for 2013. 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.

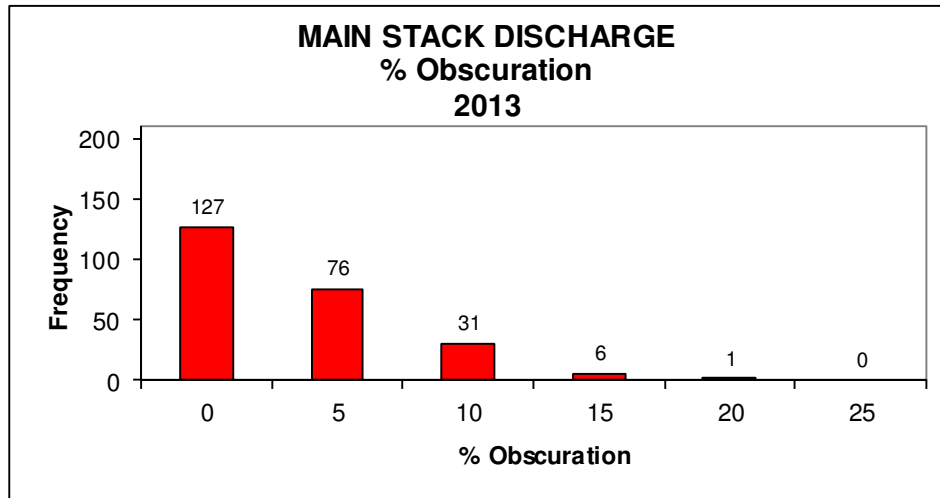
Dust Collector	Date	Total particulate discharge mg/Sm ³
Mill East	11/1/13	34
Mill East	11/1/13	55
Mill West	15/1/13	1
Mill West	18/1/13	2
Butt Cleaner	27/5/13	13
Butt Cleaner	28/5/13	13
Reamer	8/7/13	16
Reamer	10/7/13	48
Ship Unloader Port	30/8/13	1
Ship Unloader Port	30/8/13	1
Ship Unloader Stbd	30/8/13	1
Ship Unloader Stbd	30/8/13	2
Induction Furnace	15/8/13	0
Induction Furnace	16/8/13	0
Butt Fines	21/8/13	51
Butt Fines	22/8/13	94
Flakt	16/10/13	2
Flakt	16/10/13	1
Spray Station	18/10/13	30
103	12/12/13	1
103	12/12/13	1

Comments

All dust collectors tested during 2013 were within the consent level of 250 mg/Sm³ within none over the action limit of 100 mg/Sm³.

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 2013.



During 2013 there was a decrease in the frequency of observations in the 1 to 5% range, a slight increase in the 10% 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 2013.

Material	Units	Permit Maximum	2013 Annual Average	2013 Maximum	2013 Minimum
Petroleum Coke	%	4	3.11	3.27	2.89
Pitch	%	1	0.49	0.62	0.42
Heavy Fuel Oil	%	3.5	2.44	2.87	2.02

Comments

All shipments of raw materials and fuels during the 2013 met the permit standards for sulphur content.

During 2013 the average sulphur content of the Petroleum Coke increased from 2.85 to 3.11%, while shipments of Heavy fuel oil have also slightly increased in sulphur content. Sulphur content of Pitch remained unchanged.

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

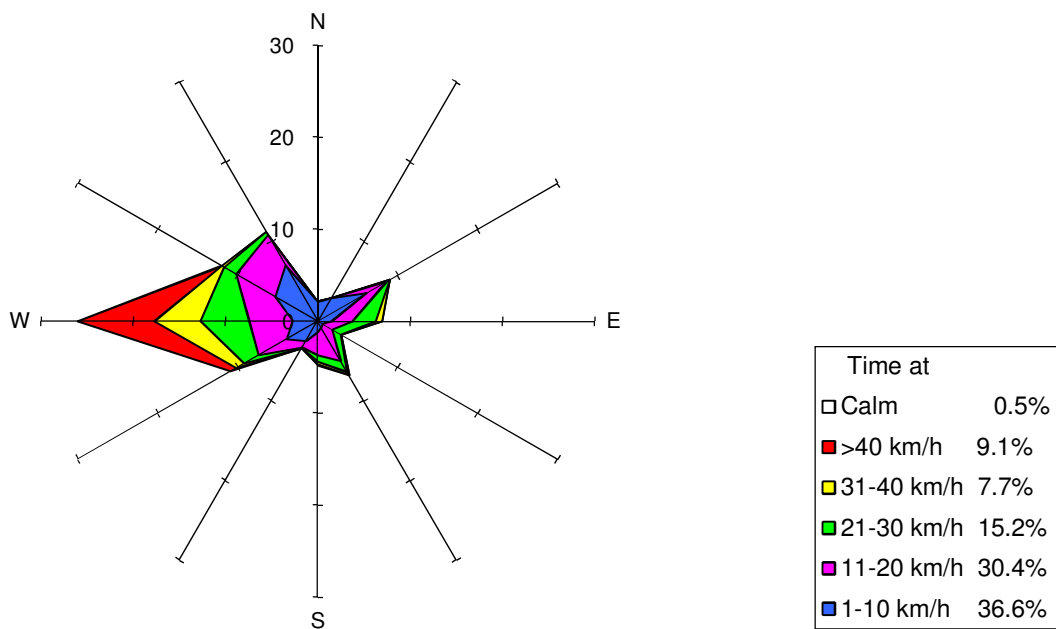
The mean wind frequency diagram on the following page shows that the 2013 wind pattern was dominated by westerly, north-westerly and north-easterly winds. Dispersion conditions are similar to previous years.

The following table shows the predominant winds and total rainfall recorded for each month during 2013.

Month	Predominant Wind Direction	Rainfall (mm)
January	West and southeast	156
February	West	36
March	West and	24
April	West, east and northwest	139
May	Northwest, west, southwest, and east	92
June	West and northwest	94
July	Northwest, west and southwest	141
August	Northeast, northwest and west	48
September	West, northeast and northwest	126
October	West and northwest	186
November	West, southeast and southwest	55
December	West, northeast and southwest	86

Total rainfall for the year is 1183 mm. The five year average is 1049mm. The long term average is 1104mm of rainfall.

New Zealand Aluminium Smelters Limited - Tiwai Point
Mean Wind Frequency (%) of Surface Wind Directions
Period: 2013



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 $0.5 \mu\text{g}/\text{m}^3$

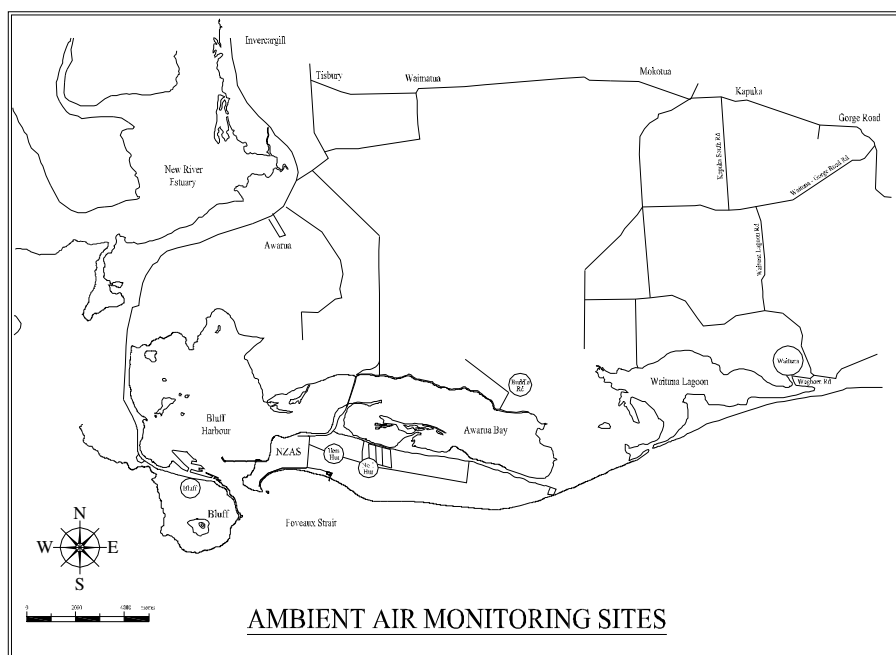
The limits apply to measurements on land other than Tiwai Peninsula and on Tiwai Peninsula east of Rio Tinto Alcan freehold land.

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

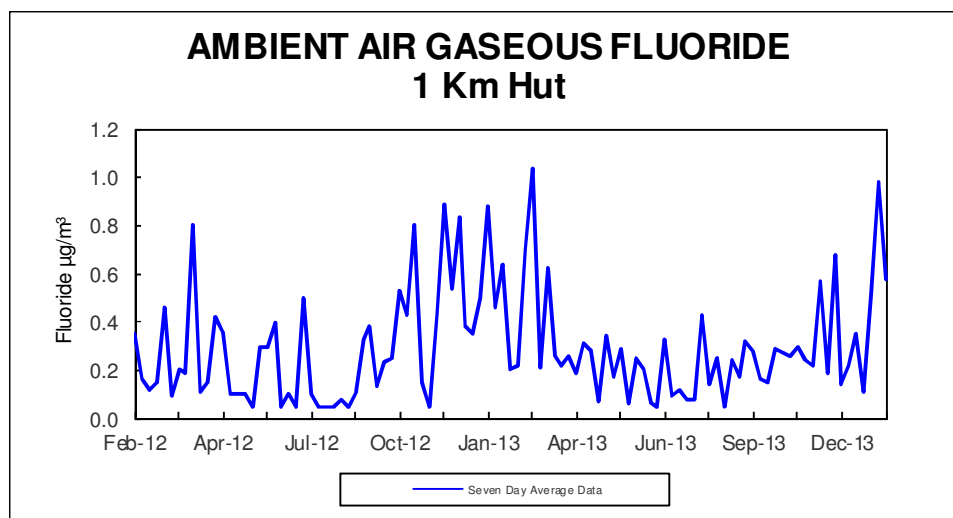
Monitoring results

The following table summarises the monitoring results during 2012 and 2013. The sampling frequency for ambient air fluoride at this site is seven days.

Parameter	Units	2012	2013
Gaseous Fluoride Concentration			
• Max 7 day average	$\mu\text{g}/\text{m}^3$	0.90	1.00
• Max monthly average	$\mu\text{g}/\text{m}^3$	0.50	0.60
• Annual average	$\mu\text{g}/\text{m}^3$	0.27	0.28
Particulate fluoride concentration			
• Max 7 day average	$\mu\text{g}/\text{m}^3$	0.50	0.40
• Max monthly average	$\mu\text{g}/\text{m}^3$	0.20	0.20
• Annual average	$\mu\text{g}/\text{m}^3$	< 0.1	< 0.1

Gaseous fluoride

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

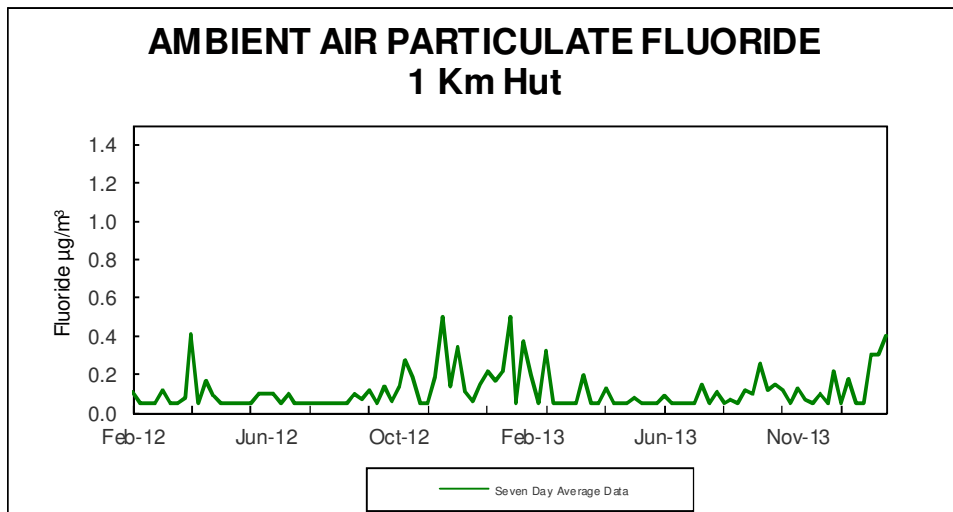


Note: Concentrations less than $0.1 \mu\text{g}/\text{m}^3$ are plotted as $0.05 \mu\text{g}/\text{m}^3$

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 2012.

Ambient Air at No. 1 Bore on Tiwai Peninsula

Monitoring results

The following table summarises the monitoring results during 2012 and 2013 for the No. 1 Bore site located on Tiwai Peninsula.

Site	Parameter	Units	Limit	2012	2013
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	0.10	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 2013.

Ambient Air at Sites off Tiwai Peninsula

Monitoring results

The following table summarises the monitoring results during 2012 and 2013 for the three ambient air-monitoring sites located off Tiwai Peninsula.

Site	Parameter	Units	Limit	2012	2013
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
	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
Bluff	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 2013.

Part E - Atmospheric Deposition

Introduction

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

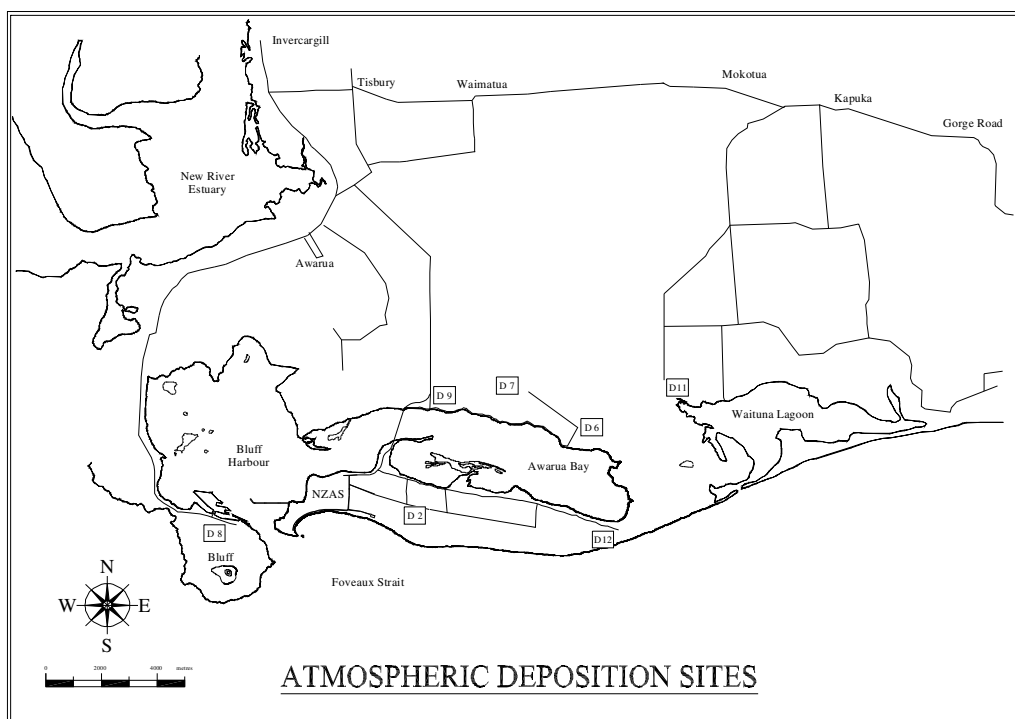
Permit Guidelines

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

Parameter	Unit	Guideline
Fluoride:	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 2013 is summarised in the following table.

Site	Units	2013 Average	Maximum for any month	Minimum for any month
D2. No.1 Bore ¹	g.m ⁻³	0.36	1.96	<0.06
D12 TEF2 ¹	g.m ⁻³	0.06	0.34	<0.06
D6 Buddle Road	g.m ⁻³	0.07	0.22	<0.06
D7 Gibson's Farm	g.m ⁻³	<0.06	0.11	<0.06
D8 Bluff	g.m ⁻³	<0.06	0.19	<0.06
D9 Awarua Bay Road	g.m ⁻³	<0.06	0.19	<0.06
D11 Marshall Road	g.m ⁻³	<0.06	0.12	<0.06

¹ Site located on Tiwai Peninsula and excluded from permit guideline.

Comments

All permit guidelines were met during 2013. Fluoride deposition during 2013 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.

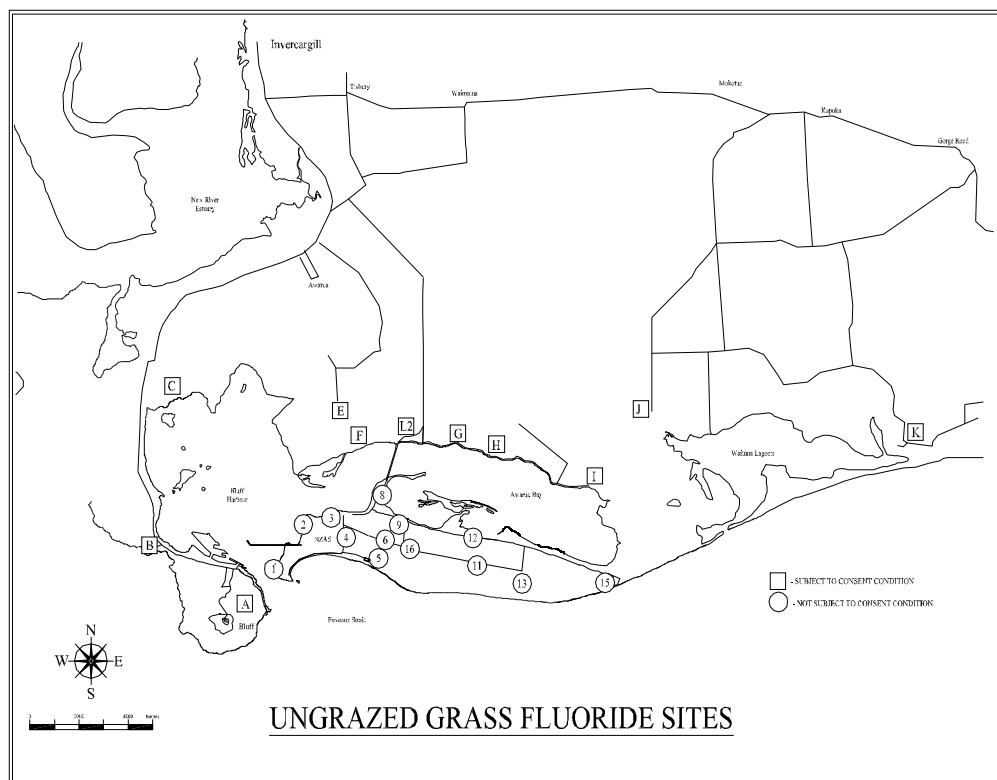
Permit Guidelines

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 2012 and 2013. The permit guideline only applies to land other than Tiwai Peninsular (sites A to L2).

Site	Permit Guideline mg/kg	2013 Average mg/kg	2014 Average mg/kg
1	NA	8	14
2	NA	60	91
3	NA	37	47
4	NA	604	375
5	NA	17	12
6	NA	68	71
8	NA	11	13
9	NA	25	20
11	NA	8	8
12	NA	10	10
13	NA	5	5
15	NA	3	4
16	NA	17	16
A	40	5	4
B	40	4	4
C	40	20	17
E	40	3	5
F	40	4	4
G	40	6	5
H	40	9	7
I	40	5	5
J	40	3	4
K	40	3	4
L2	40	5	6

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 2013.

Sites off Tiwai Peninsula	Permit Guideline not to be exceeded more than once in any 12 month consecutive months. mgF/kg	Maximum Monthly Result During 2014 mgF/kg
Ungrazed Grass Site A	80	10
Ungrazed Grass Site B	80	10
Ungrazed Grass Site C	80	55
Ungrazed Grass Site E	80	13
Ungrazed Grass Site F	80	6
Ungrazed Grass Site G	80	14
Ungrazed Grass Site H	80	27
Ungrazed Grass Site I	80	9
Ungrazed Grass Site J	80	10
Ungrazed Grass Site K	80	6
Ungrazed Grass Site L2	80	11

The monthly fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2013. 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 2013.

Sites off Tiwai Peninsula	Permit Guideline mgF/kg	Maximum Two Month Running Average During 2014 mgF/kg
Ungrazed Grass Site A	60	9
Ungrazed Grass Site B	60	9
Ungrazed Grass Site C	60	60
Ungrazed Grass Site E	60	10
Ungrazed Grass Site F	60	6
Ungrazed Grass Site G	60	9
Ungrazed Grass Site H	60	18
Ungrazed Grass Site I	60	9
Ungrazed Grass Site J	60	7
Ungrazed Grass Site K	60	6
Ungrazed Grass Site L2	60	10

The two month running average fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2013. 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 2013.

Sites off Tiwai Peninsula	Permit Guideline mgF/kg	Maximum Twelve Month Running Average During 2014 mgF/kg
Ungrazed Grass Site A	40	6
Ungrazed Grass Site B	40	6
Ungrazed Grass Site C	40	25
Ungrazed Grass Site E	40	5
Ungrazed Grass Site F	40	5
Ungrazed Grass Site G	40	6
Ungrazed Grass Site H	40	9
Ungrazed Grass Site I	40	6
Ungrazed Grass Site J	40	4
Ungrazed Grass Site K	40	4
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 2013.

Comments

The 2013 annual average fluoride concentrations in all ungrazed grass sites off Tiwai Peninsula were similar to the annual average fluoride concentration levels in 2012.

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

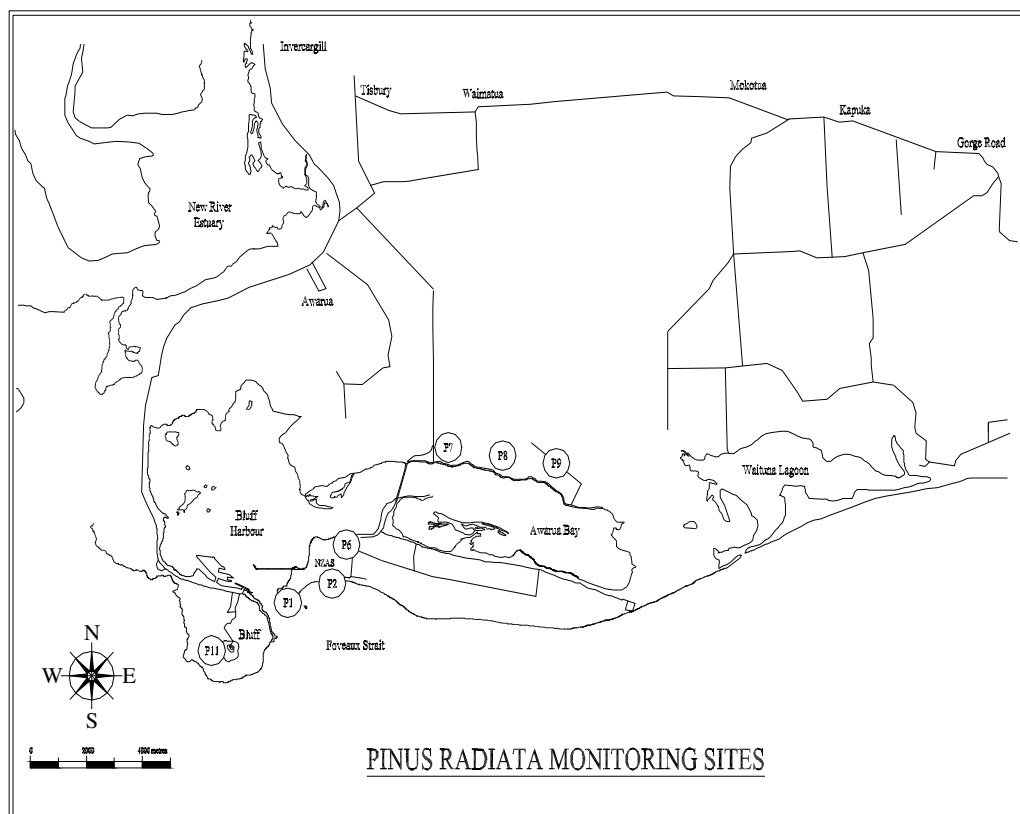
This chapter covers the monitoring of fluoride in *Pinus radiata* at seven monitoring sites located at Bluff, Awarua Plains, Waituna and Tiwai Peninsula.

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 2012 and 2013 for the sites on and off Tiwai Peninsular. Guidelines apply only to land other than Tiwai Peninsular.

Sites on Tiwai Peninsular	Units	Guideline	2012 Average	2013 Average
P1	mg/kg	NA	12	11
P2B	mg/kg	NA	98	53
P6	mg/kg	NA	165	82

NA – Guideline not applicable.

Sites off Tiwai Peninsular	Units	Guideline	2012 Average	2013 Average
P7	mg/kg	75	16	6
P8	mg/kg	75	5	3
P9	mg/kg	75	9	9
P11	mg/kg	75	4	2

Comments

Fluoride concentrations in *Pinus radiata* needles sites off Tiwai Peninsula were within the permit guideline during 2013. 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

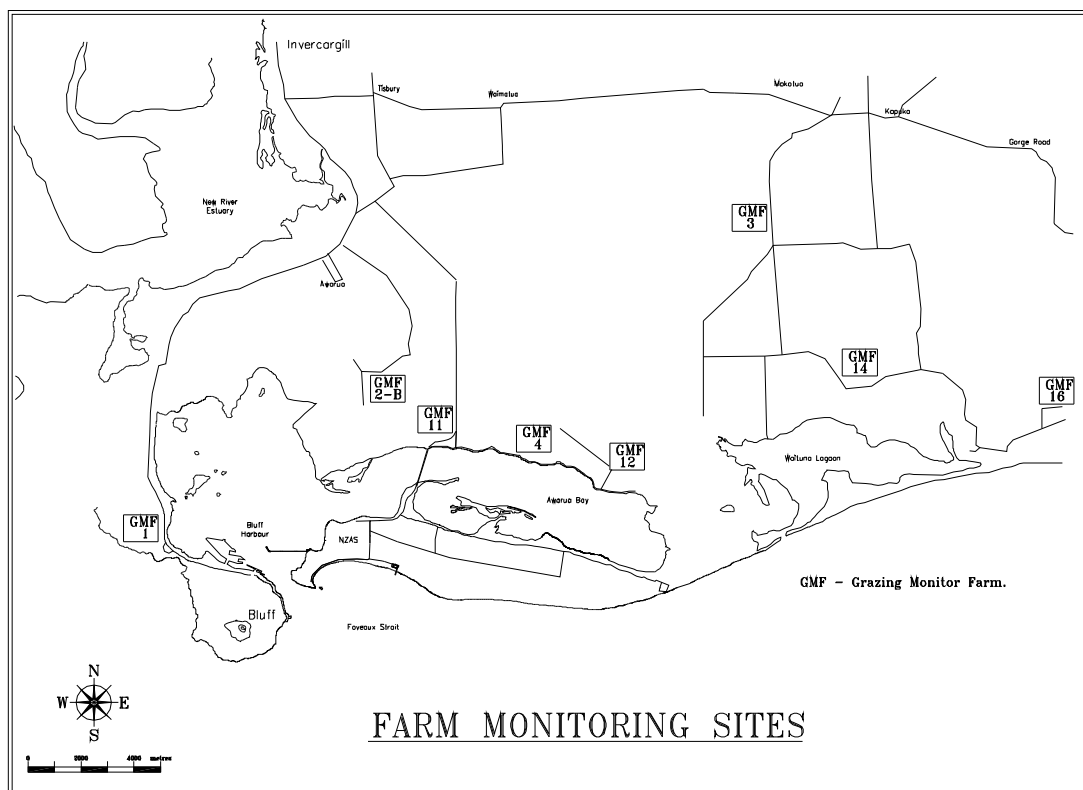
Introduction

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 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.

Results

Grazing Monitor Farm No.1

Introduction

The following information is contained in this section:

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

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:

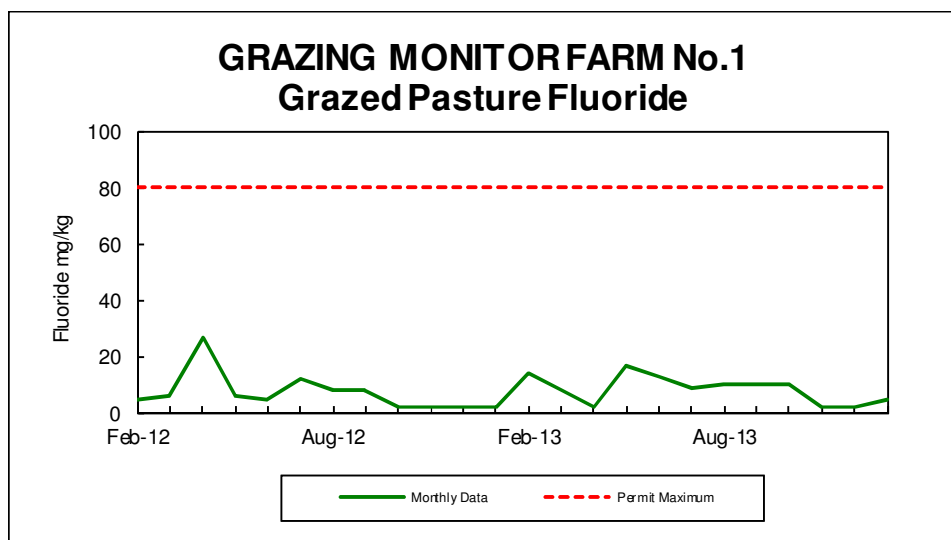
- monthly sample shall not exceed 80 mg/kg more than once in any 12 consecutive months,
- the average of any two consecutive months samples shall not exceed 60 mg/kg,
- running averages of monthly samples for a period of twelve months shall not exceed 40 mg/kg.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2013.

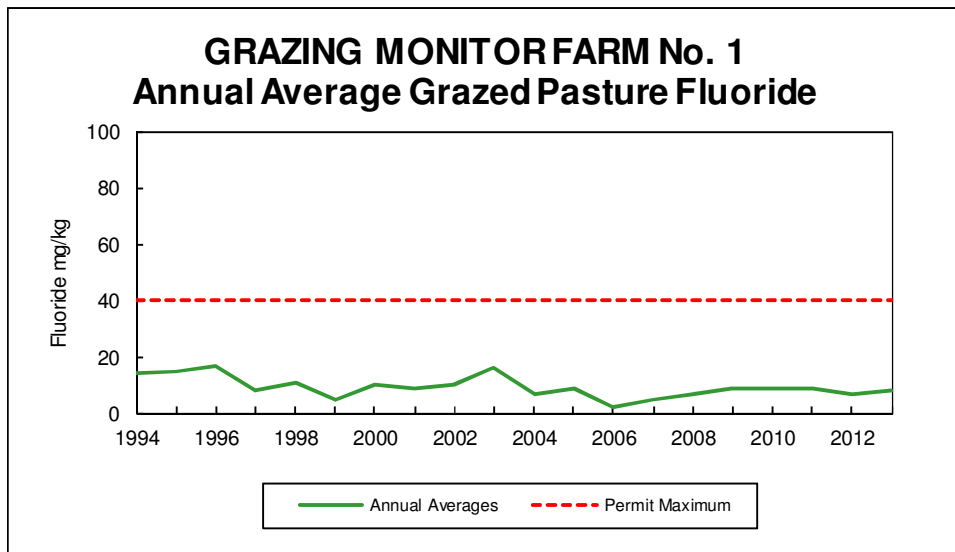
	Units	Standard	2013
Monthly sample maximum	mg/kg	80	17
Two monthly average maximum	mg/kg	60	15
Twelve monthly running average maximum	mg/kg	40	8
Annual average	mg/kg		8

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2012 and 2013.



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 2013 average grazed pasture fluoride concentration of 8 mg/kg was similar to the 2012 average.

Grazing Monitor Farm No. 2

Introduction

The following information is contained in this section:

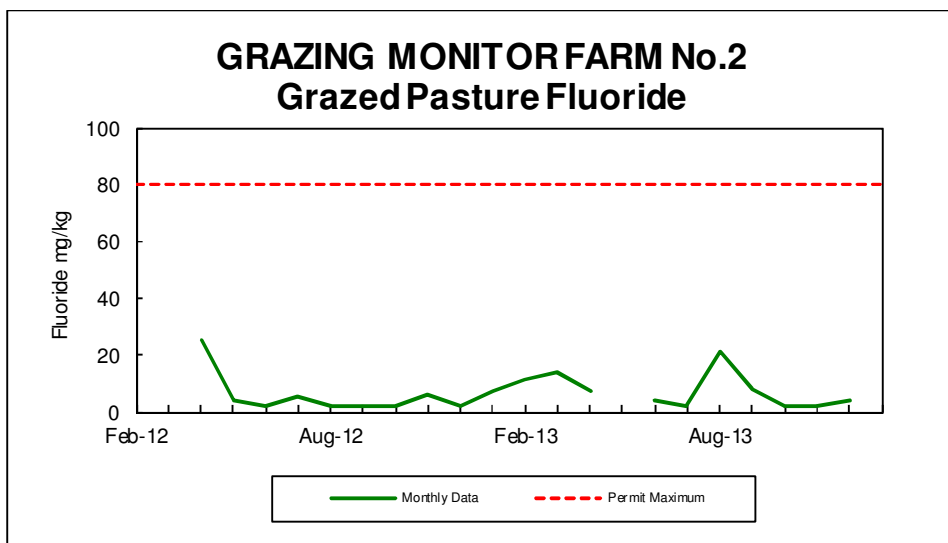
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2013.

	Units	Standard	2013
Monthly sample maximum	mg/kg	80	21
Two monthly average maximum	mg/kg	60	15
Twelve monthly running average maximum	mg/kg	40	8
Annual average	mg/kg		7

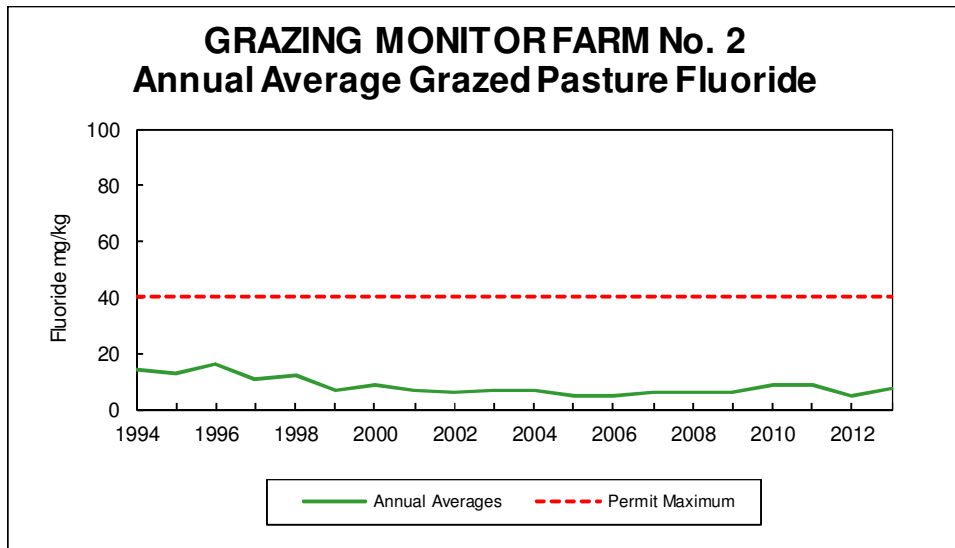
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2012 and 2013.



No data for March 2012 or May 2013 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 2013 average grazed pasture fluoride concentration of 7 mg/kg was similar to the average fluoride concentration measured during 2012.

Grazing Monitor Farm No. 3

Introduction

The following information is contained in this section:

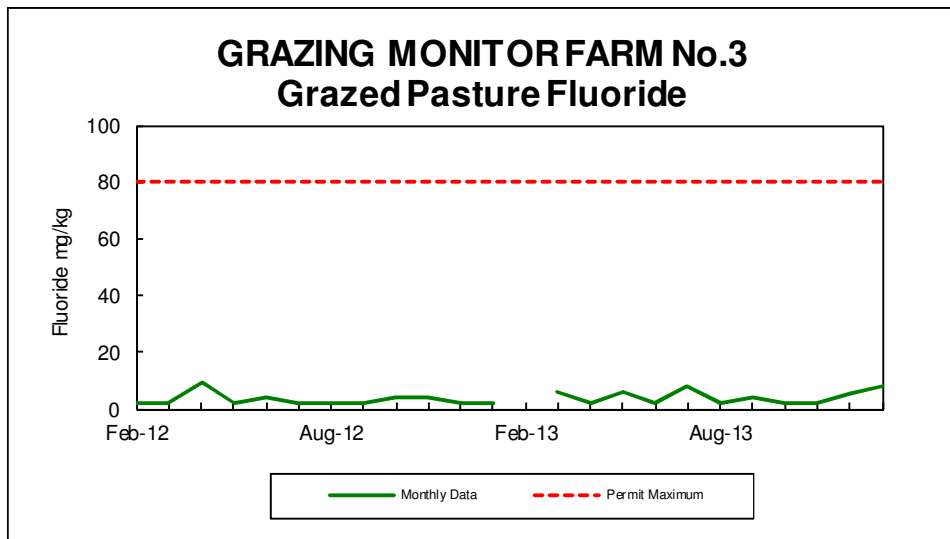
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2013.

	Units	Standard	2013
Monthly sample maximum	mg/kg	80	8
Two monthly average maximum	mg/kg	60	5
Twelve monthly running average maximum	mg/kg	40	4
Annual average	mg/kg		4

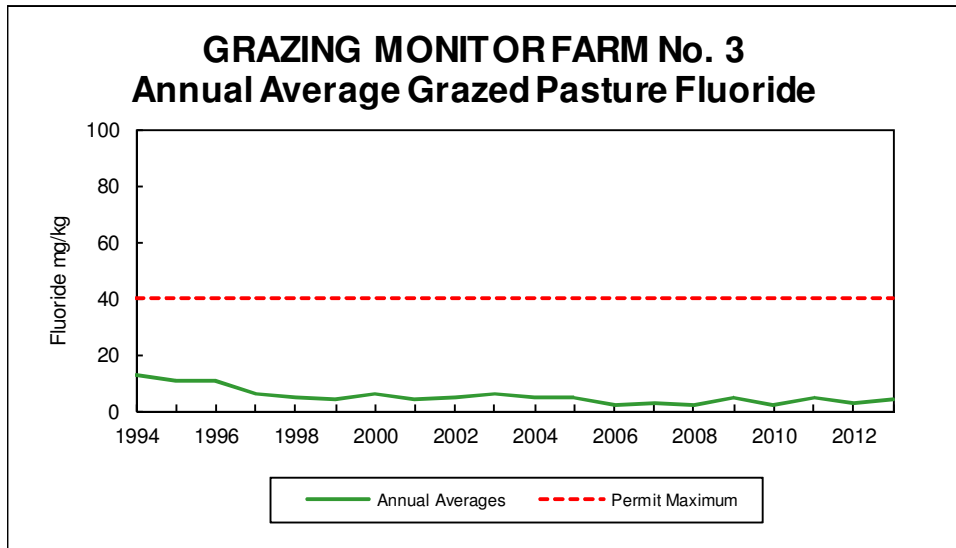
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2012 and 2013.



No data for February 2013 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 2013 annual average grazed pasture fluoride concentration of 4 mg/kg was similar to the average fluoride concentration measured during 2012.

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.

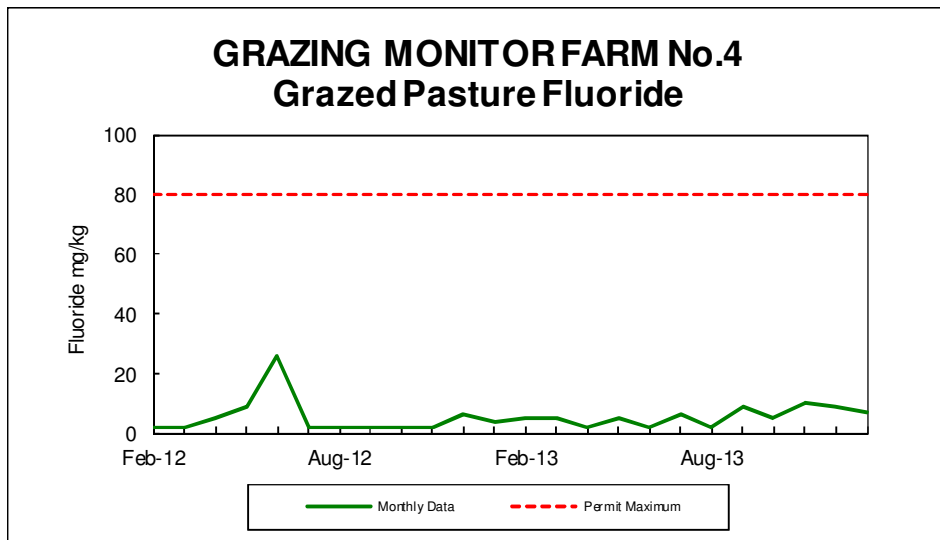
This farm was sold in late 2006 and the new owner has changed the farming practice for this farm. This farm has been converted from a sheep and cattle farm to dairy.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2013.

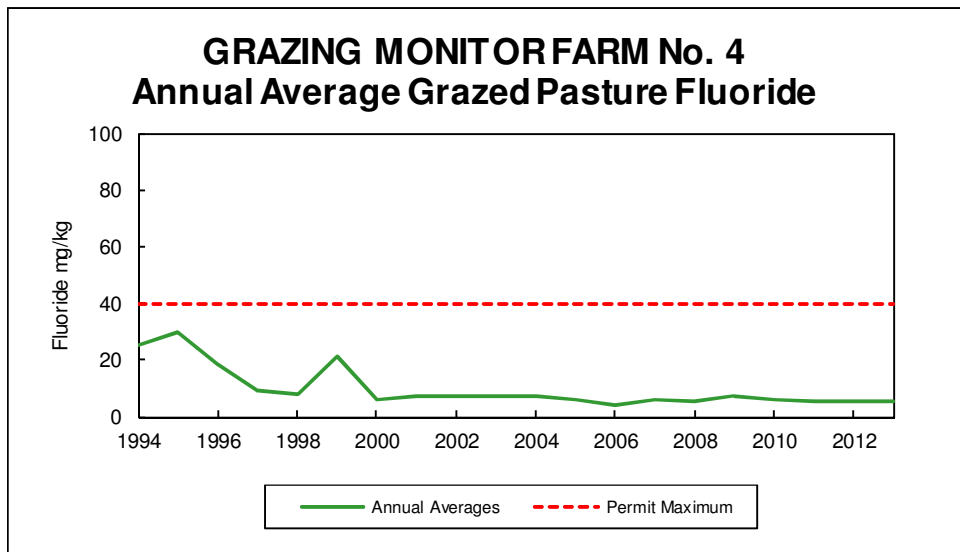
	Units	Standard	2013
Monthly sample maximum	mg/kg	80	10
Two monthly average maximum	mg/kg	60	10
Twelve monthly running average maximum	mg/kg	40	6
Annual average	mg/kg		5

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2012 and 2013.



Grazing Monitor Farm No. 4, continued

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

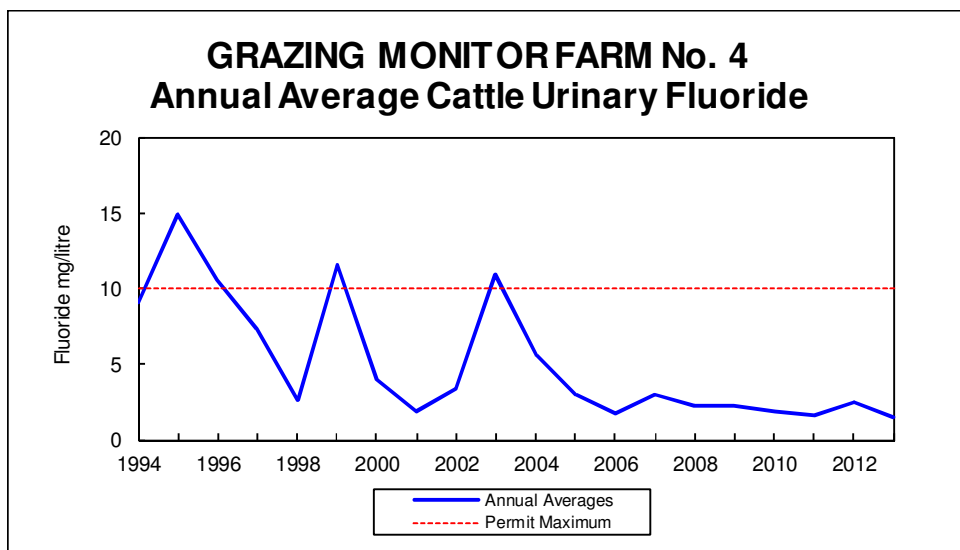


Cattle urinary fluoride

The following table summarises the results of cattle urinary fluoride monitoring during 2013.

	Units	Guideline	2013
Average fluoride concentration	mg/L	-	1
Maximum fluoride concentration	mg/L	10	2
Minimum fluoride concentration	mg/L	-	1
No. of samples	mg/L	-	6

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 2013.

The 2013 annual average grazed pasture fluoride concentration of 5 mg/kg was similar to that determined during 2012.

The annual average urinary fluoride concentration measured during 2013 was 1 mg/L similar to the average measured during 2012. 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:

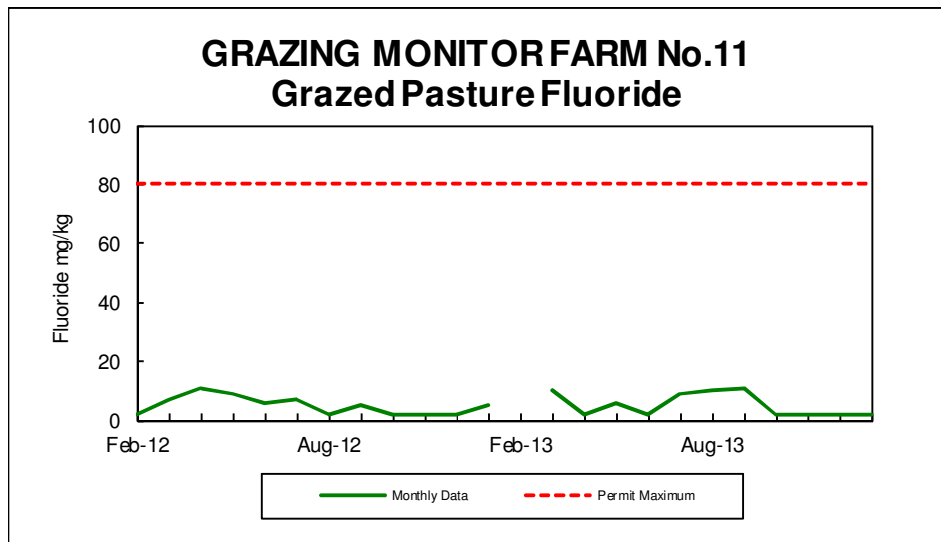
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2013.

	Units	Standard	2013
Monthly sample maximum	mg/kg	80	11
Two monthly average maximum	mg/kg	60	11
Twelve monthly running average maximum	mg/kg	40	6
Annual average	mg/kg		6

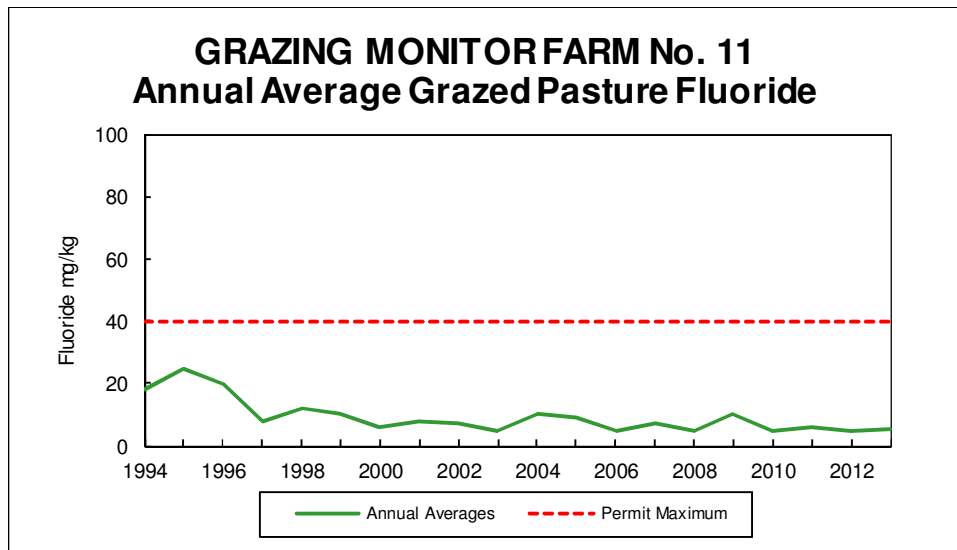
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2012 and 2013.



There is no data for February 2013 as fertilizer has been applied within 28 days of sampling.

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 2013 average grazed pasture fluoride concentration of 6mg/kg is a similar to the fluoride concentration measured during 2012.

Grazing Monitor Farm No. 12

Introduction

The following information is contained in this section:

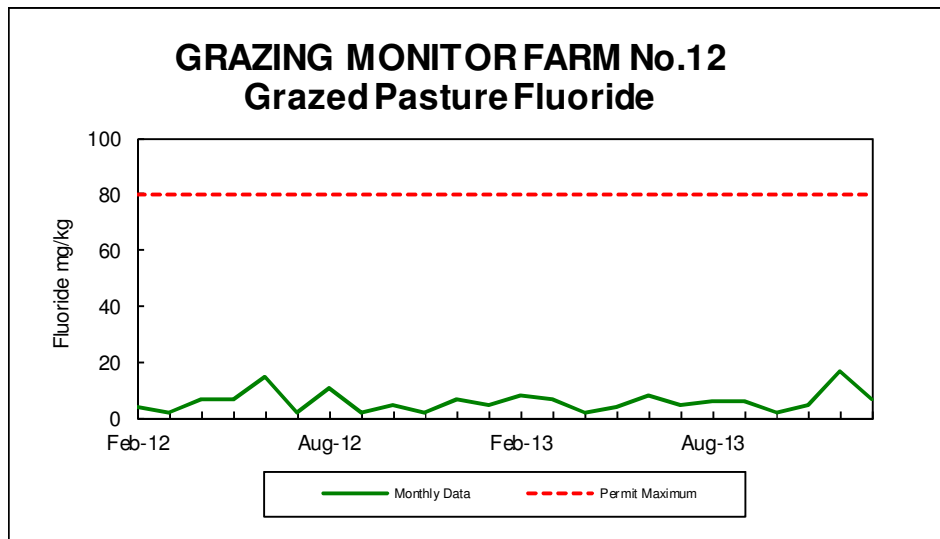
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the maximum grazed pasture monitoring results for 2013.

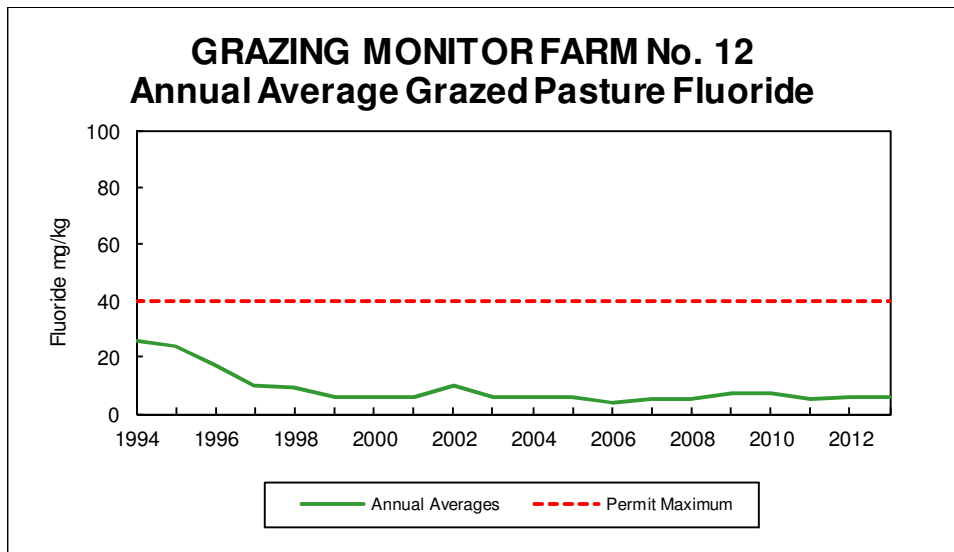
	Units	Standard	2013
Monthly sample maximum	mg/kg	80	17
Two monthly average maximum	mg/kg	60	11
Twelve monthly running average maximum	mg/kg	40	7
Annual average	mg/kg		6

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2012 and 2013.



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 2013 annual average grazed pasture fluoride concentration of 6 mg/kg is similar to the average concentration measured in 2012.

Grazing Monitor Farm No. 14

Introduction

The following information is contained in this section:

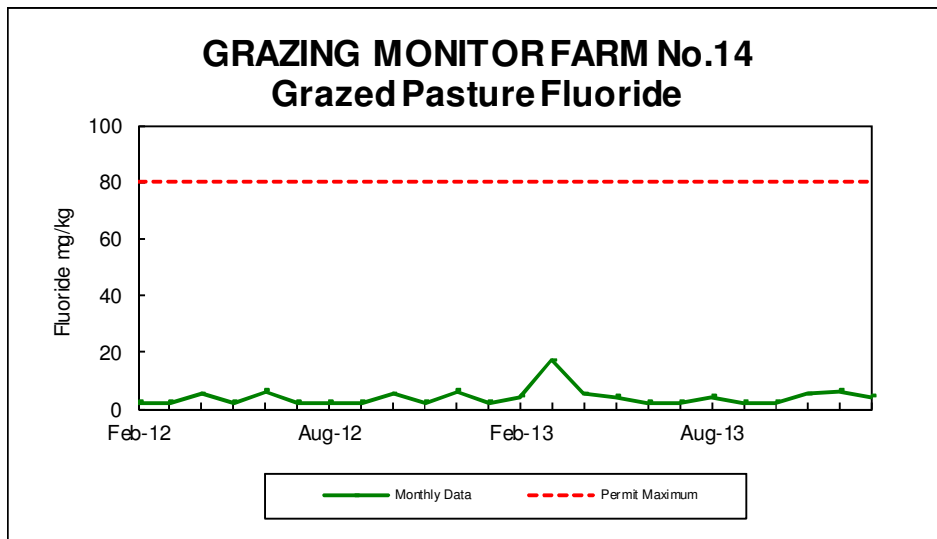
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2013.

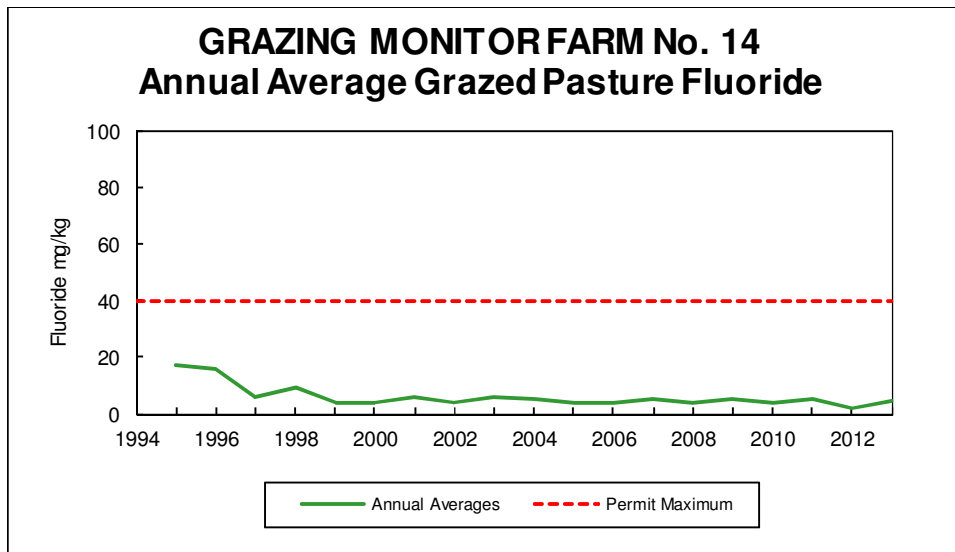
	Units	Standard	2013
Monthly sample maximum	mg/kg	80	17
Two monthly average maximum	mg/kg	60	11
Twelve monthly running average maximum	mg/kg	40	5
Annual average	mg/kg		5

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2012 and 2013.



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 2013. The 2013 annual average grazed pasture fluoride concentration of 5 mg/kg was similar to the average concentration measured during 2012.

Grazing Monitor Farm No. 16

Introduction

The following information is contained in this section:

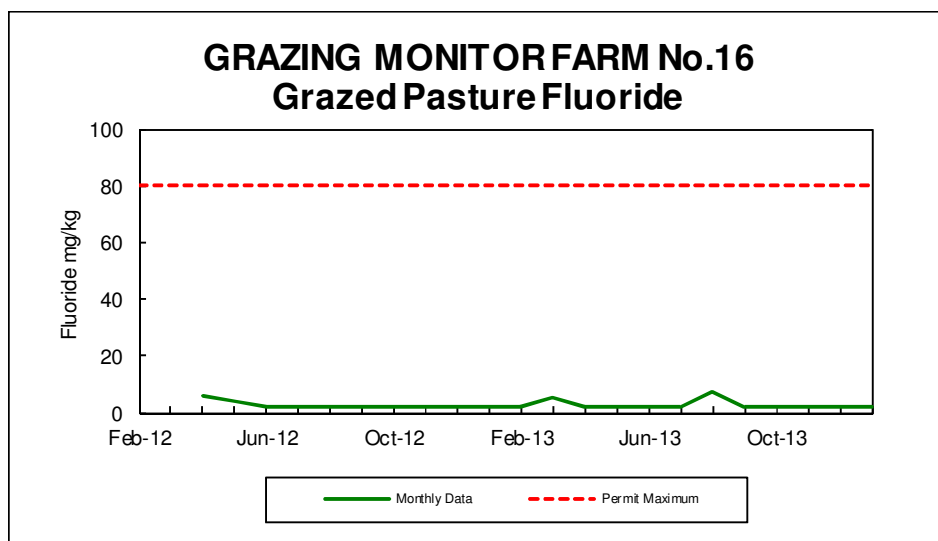
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2013.

	Units	Standard	2013
Monthly sample maximum	mg/kg	80	7
Two monthly average maximum	mg/kg	60	5
Twelve monthly running average maximum	mg/kg	40	3
Annual average	mg/kg		< 4

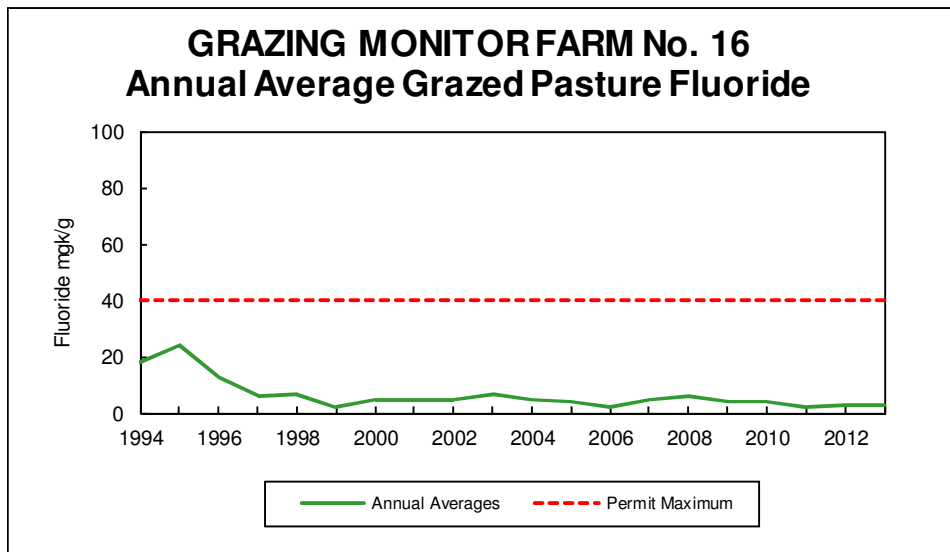
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2012 and 2013.



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 2013. The 2013 annual average grazed pasture fluoride concentration of <4 mg/kg was similar to the concentration measured in 2012.

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 12th September 2005.

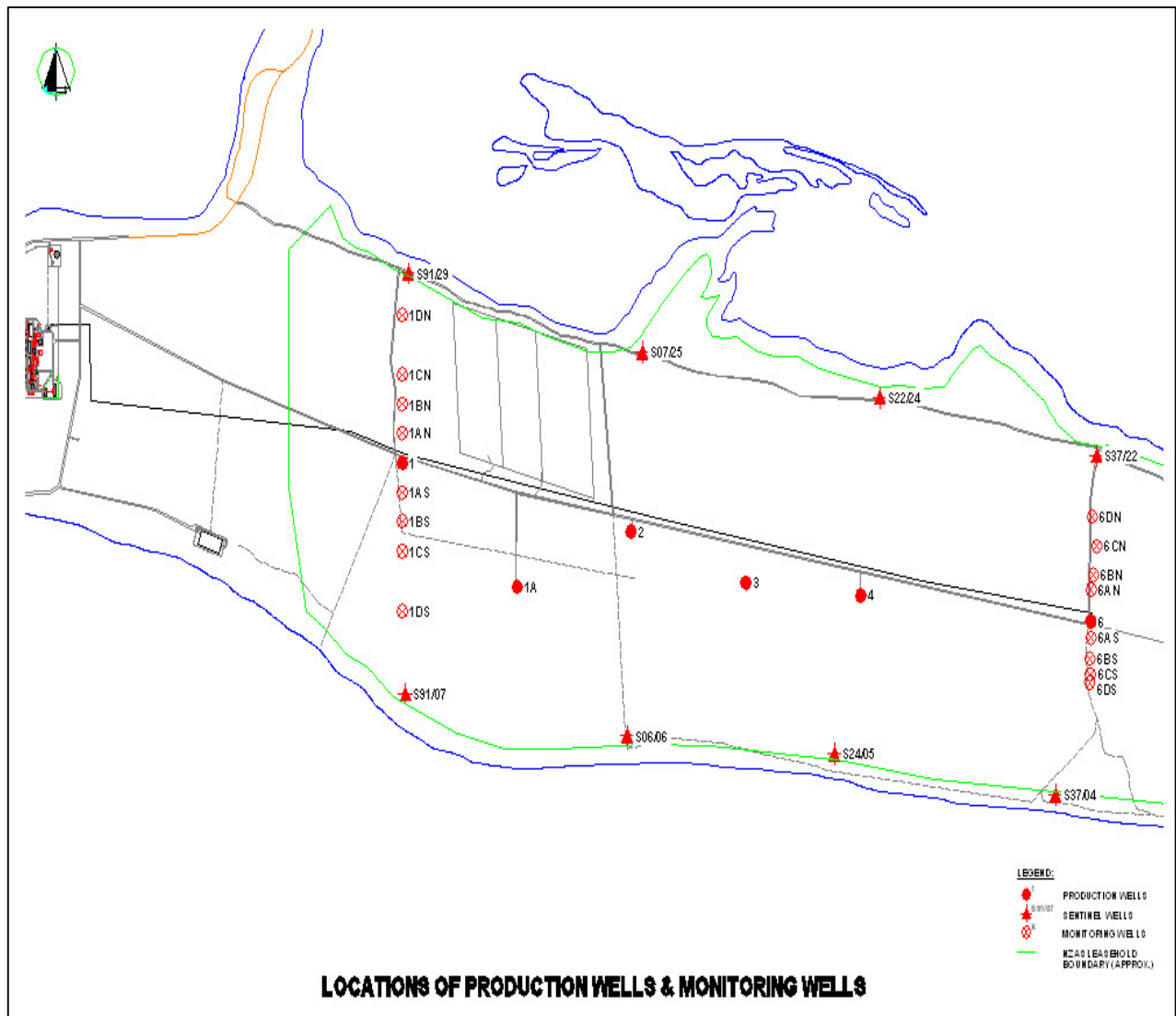
Permit Conditions

Total abstraction rate not to exceed 4,564 m³/day.

Results of monitoring to be reported to the Council by the 31st March each year.

Site Locations

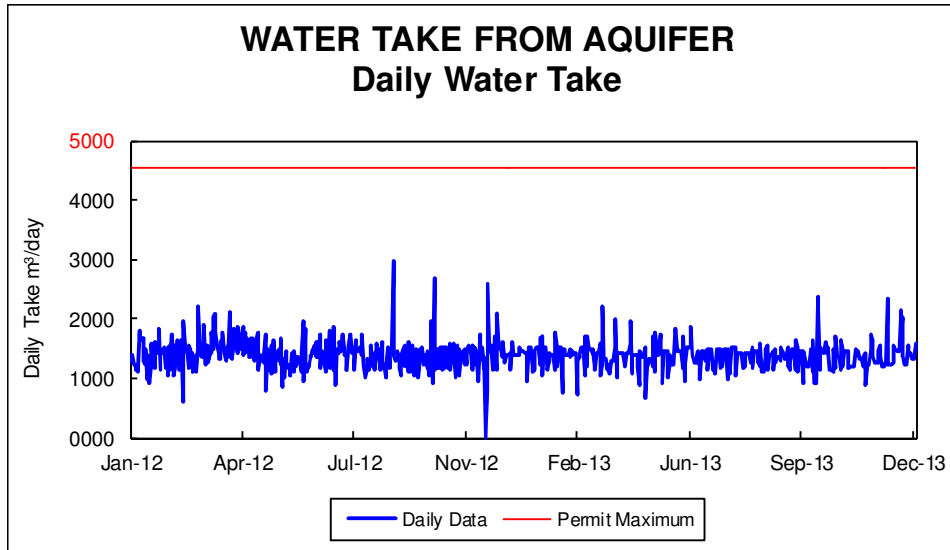
The locations of the Production and Monitoring Water Wells are shown in the following map.



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 no 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.



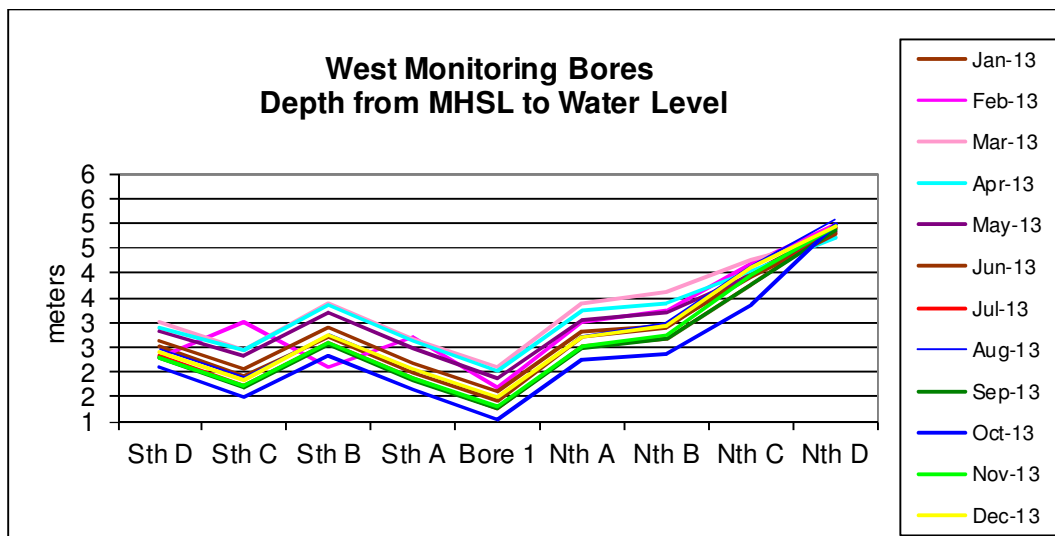
The table below summarises the daily data on a monthly basis.

Daily Water Take		
Date	Average m3/day	Maximum m3/day
Jan-13	1388	1777
Feb-13	1367	1716
Mar-13	1386	2228
Apr-13	1334	1964
May-13	1411	1843
Jun-13	1370	1880
Jul-13	1355	1520
Aug-13	1358	1572
Sep-13	1299	1649
Oct-13	1432	2380
Nov-13	1338	1729
Dec-13	1441	2345

Water Take from Aquifer, continued

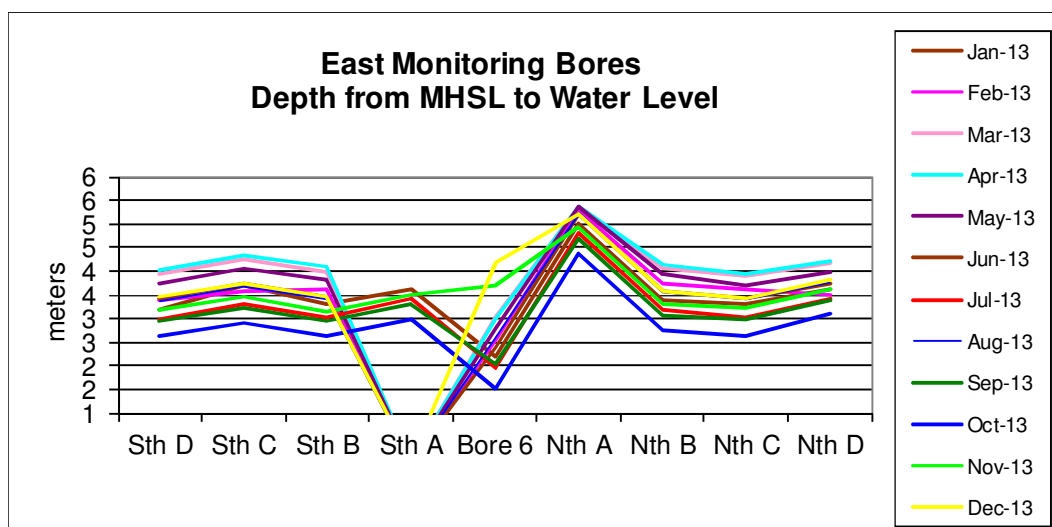
The following tables and graphs show the water level for each monitoring bore around production bores 1 and 6, measured while pumping from the production bores.

West Monitoring Bore Water Levels (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-13	2.50	1.90	3.30	2.00	1.40	2.70	2.90	4.00	4.90
Feb-13	2.30	3.00	3.60	2.70	1.70	3.00	3.25	4.20	4.98
Mar-13	3.01	2.45	3.96	2.68	2.10	3.40	3.62	4.25	4.71
Apr-13	2.89	2.43	4.08	2.63	2.02	3.24	3.37	4.04	4.73
May-13	2.81	2.31	3.83	2.47	1.86	3.06	3.18	3.95	4.83
Jun-13	2.62	2.05	3.48	2.19	1.60	2.81	2.93	3.91	4.80
Jul-13	2.32	1.73	3.04	1.87	1.27	2.50	2.66	3.77	4.91
Aug-13	2.47	1.88	3.40	2.05	1.49	2.72	2.98	4.13	5.09
Sep-13	2.28	1.70	2.95	1.85	1.27	2.49	2.66	3.78	4.87
Oct-13	2.08	1.51	2.63	1.63	1.03	2.26	2.37	3.34	4.97
Nov-13	2.30	1.71	3.16	1.87	1.30	2.53	2.76	3.94	4.95
Dec-13	2.42	1.84	3.46	2.05	1.48	2.71	2.95	4.09	4.94



Water Take from Aquifer, continued

East Monitoring Bore Water Levels (from Mean High Sea Level in metres) <i>Total well depth in Italics</i>									
Date	South				Bore 6	North			
	D	C	B	A		A	B	C	D
	<i>4.32</i>	<i>5.35</i>	<i>5.79</i>	<i>3.82</i>	<i>8.6</i>	<i>5.46</i>	<i>5.4</i>	<i>5.45</i>	<i>5.5</i>
Jan-13	3.20	3.70	3.30	3.60	2.20	5.00	3.40	3.30	3.60
Feb-13	3.40	3.56	3.60	dry	2.55	5.30	3.72	3.60	3.50
Mar-13	3.95	4.24	3.96	dry	3.04	5.37	4.04	3.88	4.17
Apr-13	4.00	4.33	4.08	dry	3.00	5.36	4.14	3.95	4.22
May-13	3.75	4.07	3.83	dry	2.79	5.36	3.92	3.71	3.97
Jun-13	3.42	3.74	3.48	dry	2.38	5.20	3.57	3.42	3.75
Jul-13	3.00	3.30	3.04	3.43	1.97	4.80	3.17	3.03	3.44
Aug-13	3.38	3.68	3.40	dry	2.55	5.23	3.54	3.40	3.75
Sep-13	2.95	3.23	2.95	3.32	2.03	4.71	3.08	2.97	3.40
Oct-13	2.62	2.91	2.63	3.00	1.53	4.36	2.76	2.63	3.09
Nov-13	3.18	3.45	3.16	3.51	3.68	4.92	3.31	3.21	3.62
Dec-13	3.47	3.74	3.46	dry	4.18	5.20	3.56	3.43	3.81



Comments

Water levels in the monitoring bores have not changed significantly during 2013. Bore South A was dry for 7 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.

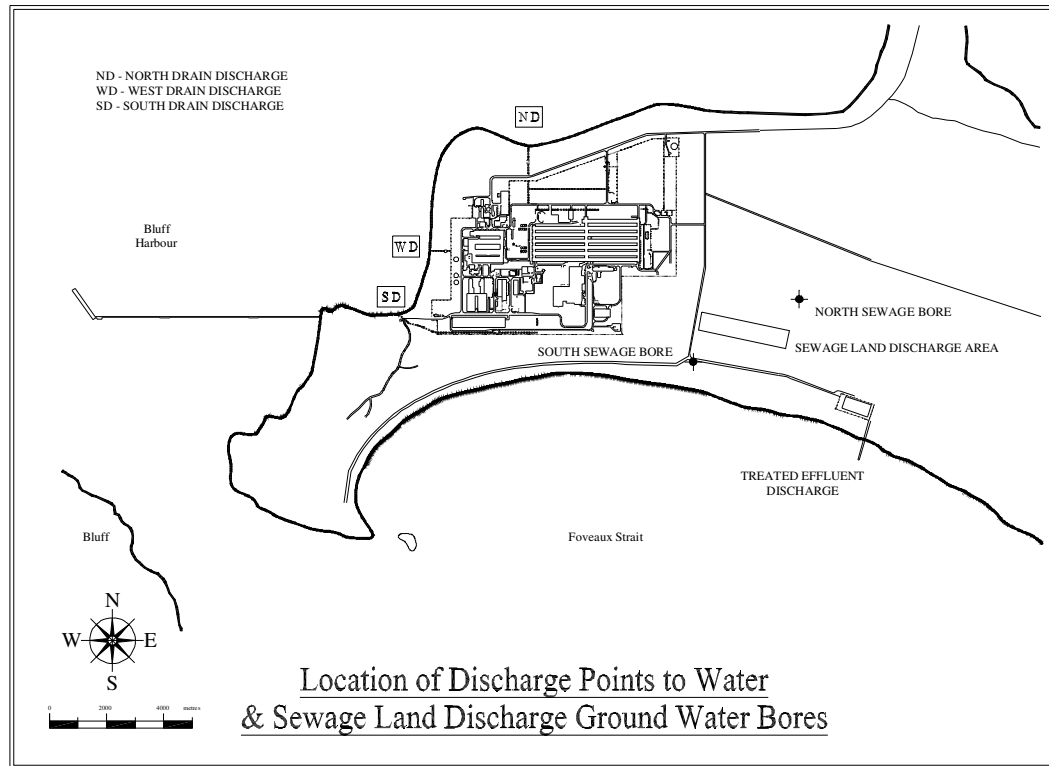
	Units	Limit
North, South, and West Drain		
• Quarterly average total suspended solids	g/m ³	30
Treated effluent		
• Maximum daily discharge	m ³ /day	140
• Total suspended solids	g/m ³	100
• Free cyanide	g/m ³	20
Treated sewage		
• Maximum daily flow	m ³ /day	295
• Biochemical oxygen demand	kg/day	18
• 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/m³ 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/m³.

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 2013 and shows a comparison with 2012 results.

Parameter	Units	Limit	2012 Average	2013 Average
Total Suspended solids	g/m ³		6.9	11.2
• Maximum Quarterly Average	g/m ³	30	8.7	12.7
• No. of Times Quarterly Average >30 g/m ³		0	0	0
pH			8.0	7.6
Fluoride	g/m ³		2.1	5.6
Conductivity	µS/cm		48388	40728

Coastal water monitoring results

The following table summarises the North Drain weekly coastal water monitoring results during 2013 and shows a comparison with 2012 results.

Parameter	Units	Limit	2012 Average	2013 Average
Fluoride	g/m ³		1.3	1.4
• Maximum Quarterly Average	g/m ³	2	1.3	1.6
• No. of Times Quarterly Average >2.0 g/m ³		0	0	0
• Maximum Individual Sample	g/m ³	5	1.8	2.9
• No of Times Individual Sample > 5.0 g/m ³			0	0
pH			8.1	8.1
Conductivity	µS/cm		51335	50735
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 2013 and shows a comparison with 2012 results.

Parameter	Units	Limit	2012 Result	2013 Result
Fluoride	g/m ³		1.3	1.4
• Maximum Quarterly Average	g/m ³		1.3	1.4
• No. of Times Quarterly Average >2.0 g/m ³			0	0
• Maximum Individual Sample	g/m ³		1.4	4.2
• No of Times Individual Sample > 5.0 g/m ³			0	0
pH			8.1	8.1
Conductivity	µS/cm		51612	50815
Visible Oil - No. of times Observed			0	0

Annual Monitoring results

The following table summarises the North Drain annual coastal water monitoring results during 2013 and shows a comparison with 2012 results.

Site	Parameter	Units	Limit	2012	2013
Discharge	Temperature	°C		12.1	17.8
Seawater	Temperature	°C	<25	12.7	17.8
	Dissolved oxygen	mg/L	>= 5	8.1	8.4
	Dissolved Oxygen Saturation	%	>80	100	105.4
Control	Temperature	°C	<25	12.4	15.1
	Dissolved oxygen	mg/L	>= 5	8.2	8.4
	Dissolved Oxygen Saturation	%	>80	98	104
	Change to temperature	°C	3	0	2.7

Comments

Discharges from the North Drain were within permit limits during 2013.

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 2013 and shows a comparison with 2012 results.

Parameter	Units	Limit	2012 Average	2013 Average
Total Suspended solids	g/m ³		2.7	3.4
• Maximum Quarterly Average	g/m ³	30	3.2	4.7
• No. of Times Quarterly Average >30 g/m ³		0	0	0
pH			7.0	6.6
Fluoride	g/m ³		5.1	5.0
Conductivity	µS/cm		442	390

Coastal water monitoring results

The following table summarises the South Drain weekly coastal water monitoring results during 2013 and shows a comparison with 2012 results.

Parameter	Units	Limit	2012 Average	2013 Average
Fluoride			1.3	1.4
• Maximum Quarterly Average	g/m ³	2	1.4	1.5
• No. of Times Quarterly Average >2.0 g/m ³	g/m ³	0	0	0
• Maximum Individual Sample		5	1.8	2.2
• No of Times Individual Sample > 5.0 g/m ³	g/m ³		0	0
pH			8.1	8.0
Conductivity			50982	48550
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 2013 and shows a comparison with 2012 results.

Parameter	Units	Limit	2012 Result	2013 Result
Fluoride	g/m ³		1.3	1.3
• Maximum Quarterly Average	g/m ³		1.3	1.4
• No. of Times Quarterly Average >2.0 g/m ³			0	0
• Maximum Individual Sample	g/m ³		1.6	1.6
• No of Times Individual Sample > 5.0 g/m ³			0	0
pH			8.1	8.1
Conductivity	µS/cm		51136	49726
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 2013.

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 2013 and shows a comparison with 2012 results.

Parameter	Units	Limit	2012 Average	2013 Average
Total Suspended solids	g/m ³		11.8	7.7
• Maximum Quarterly Average	g/m ³	30	18.3	9.2
• No. of Times Quarterly Average >30 g/m ³		0	0	0
pH			7.8	7.3
Fluoride	g/m ³		1.4	1.8
Conductivity	µS/cm		17844	7120

Coastal water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2013 and shows a comparison with 2012 results.

Parameter	Units	Limit	2012 Average	2013 Average
Fluoride			1.3	1.3
• Maximum Quarterly Average	g/m ³	2	1.3	1.3
• No. of Times Quarterly Average >2.0 g/m ³	g/m ³	0	0	0
• Maximum Individual Sample		5	1.5	1.5
• No of Times Individual Sample > 5.0 g/m ³	g/m ³		0	0
pH			8.1	8.1
Conductivity			51543	51120
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	2012 Result	2013 Result
Fluoride	g/m ³		1.3	1.3
• Maximum Quarterly Average	g/m ³		1.3	1.3
• No. of Times Quarterly Average >2.0 g/m ³			0	0
• Maximum Individual Sample	g/m ³		1.5	1.7
• No of Times Individual Sample > 5.0 g/m ³			0	0
pH			8.1	8.1
Conductivity	µS/cm		51136	49726
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 2013.

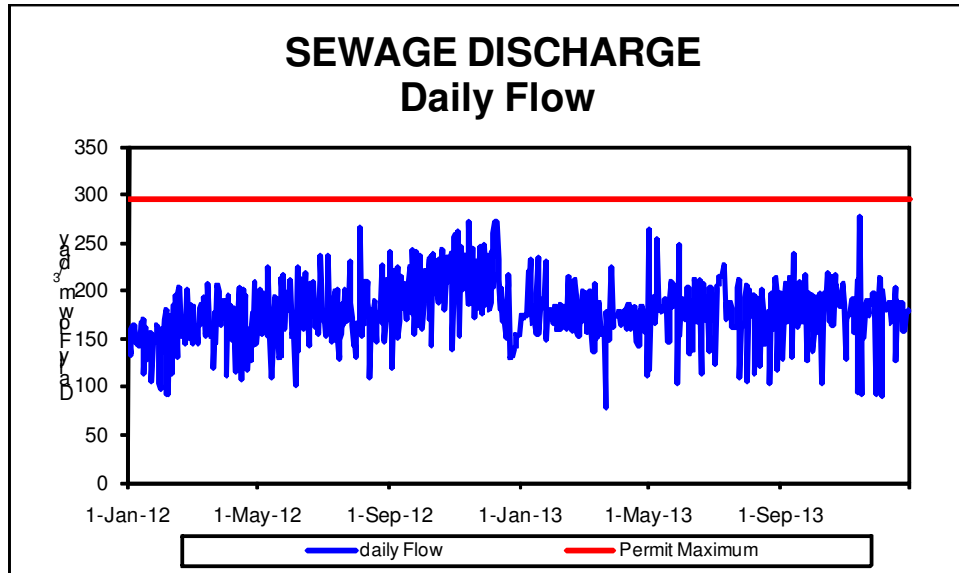
Treated Sewage Discharges

Introduction

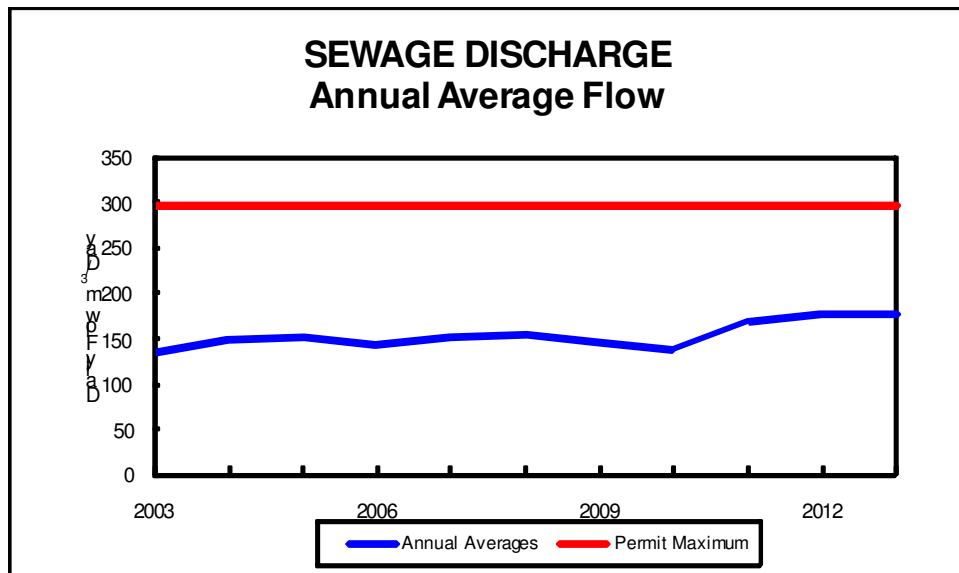
Discharges of treated sewage onto land are covered by Discharge Permit Number 203376, which was granted on 6 June 2006.

Discharge monitoring results

The following graph shows the daily sewage discharge flow during 2012 and 2013. The permit limit for daily flow is 295 m³/day.

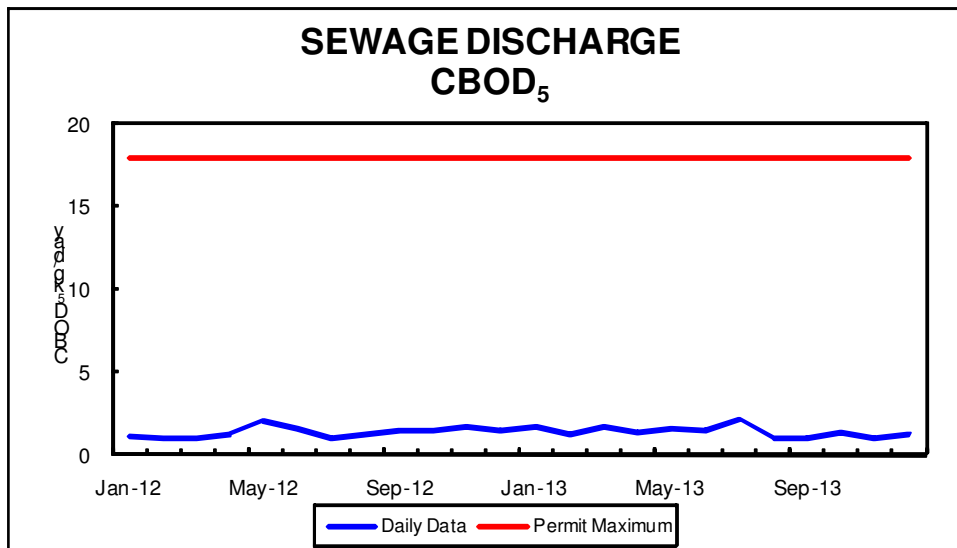


The following graph shows the annual average daily sewage discharge flow into the sewage treatment facility.

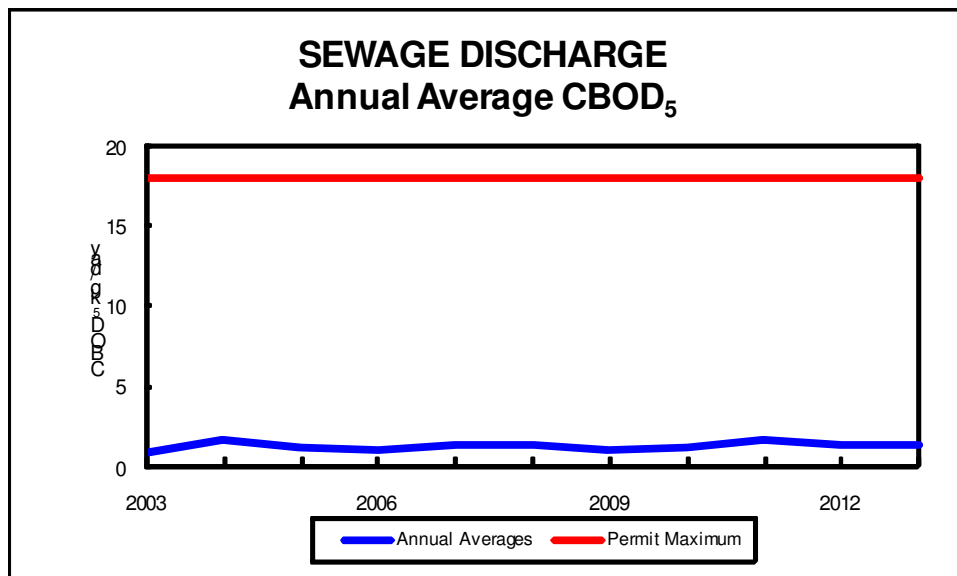


Treated Sewage Discharges, continued

The following graph shows the monthly carbonaceous biochemical oxygen demand (CBOD₅) discharge from the sewage treatment plant during 2012 and 2013. The permit limit for CBOD₅ is 18kg/day.

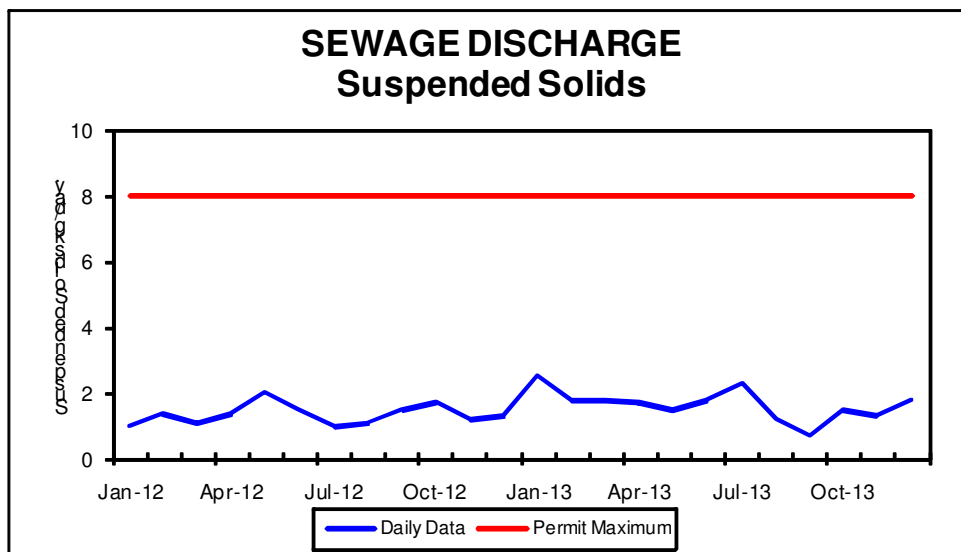


The following graph shows the annual average CBOD₅ discharge from the sewage treatment plant.

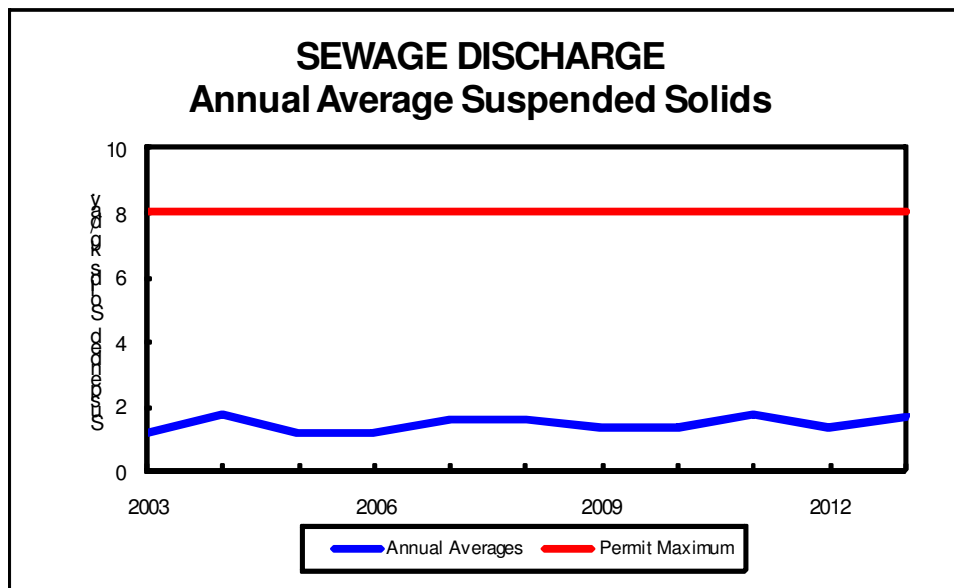


Treated Sewage Discharges, continued

The following graph shows the monthly suspended solids discharge from the sewage treatment plant during 2012 and 2013. 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 67.

Parameter	Units	2012 Average	2013 Average	Previous Range (post commission)
North Bore (Upstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2
Total phosphorus	g/m ³	0.24	0.43	0.046 - 0.64
Total ammoniacal-N	g/m ³	<0.01	< 0.01	< 0.01 - 0.03
Nitrate-N	g/m ³	<0.01	0.011	< 0.01 - 0.058
Total Nitrogen	g/m ³	0.09	0.13	0.02 - 0.4
pH		8.0	7.7	7.4 - 8.1
Conductivity	µS/cm	363	354	305 - 372
Chlorinated Aliphatic HC	g/m ³	B.L.	N.D.	B.L.
South Bore (Downstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2 - 65
Total phosphorus	g/m ³	0.031	0.09	< 0.01 - 0.14
Total ammoniacal-N	g/m ³	<0.01	<0.01	< 0.01 - 0.02
Nitrate-N	g/m ³	0.30	0.24	< 0.01 - 0.54
Total Nitrogen	g/m ³	0.51	0.62	0.05 - 0.78
pH		7.8	7.2	6.8 - 7.9
Conductivity	µS/cm	442	355	227 - 503
Chlorinated Aliphatic HC	g/m ³	B.L.	N.D.	B.L.

HC = Hydrocarbons

N.D. = Not determined.

B.L. = Below limit of detection for each of the 23 compounds determined.

Chlorinated Aliphatic Hydrocarbons only determined biennially.

Comments

The discharges of treated sewage onto land during 2013 were similar to previously seen except for phosphorous in the upstream North Bore. The phosphorous concentration in both bores has shown an increase in 2013. 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

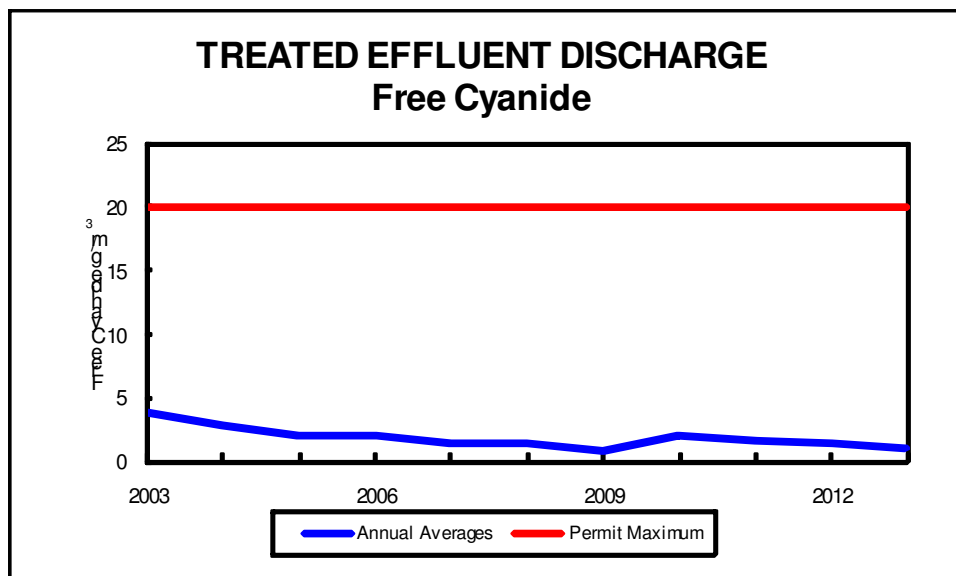
Discharges of treated effluent into Foveaux Strait are covered by Coastal Permit Number 203375 which commenced on 6 June 2006.

Discharge monitoring results

The following table summarises the results of treated effluent discharge monitoring during 2013 and shows a comparison with the 2012 results.

Parameter	Units	Limits	2012 Result	2013 Result
Maximum daily discharge	m ³ /day	140	80	80
Suspended Solids				
Maximum Concentration			93	19
Average Concentration	g/m ³	100	14.1	5.3
No.> 100 g/m ³		0	0	0
Free Cyanide				
Maximum Concentration	g/m ³	20	3.7	3.4
Average Concentration			1.4	1.0
No.> 20 g/m ³		0	0	0

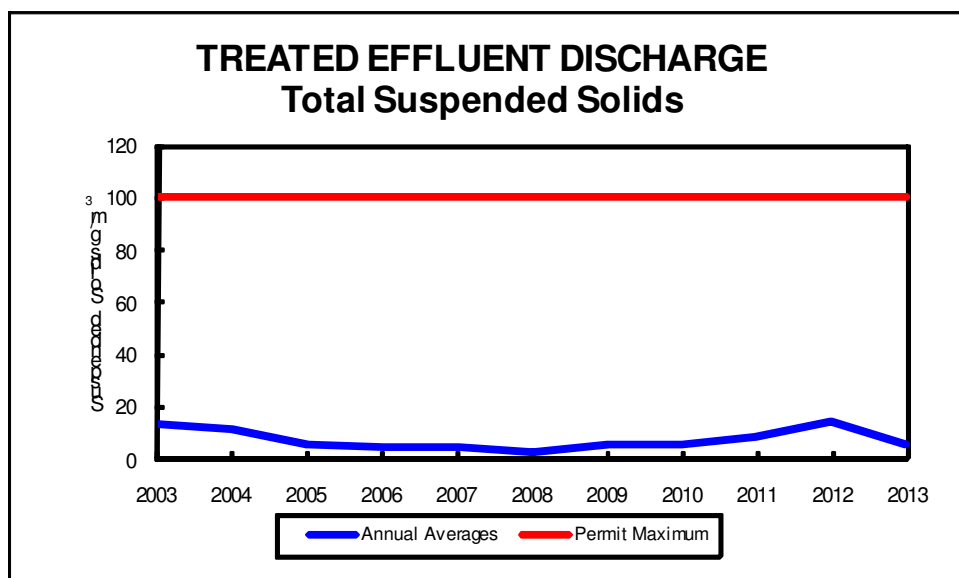
The following graph shows the annual average free cyanide concentration of treated effluent discharged.



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 2011, 2012 and 2013. There were 28 discharges throughout 2012 with a total volume of 2240 m³ discharged.

Parameter	Units	2011 Result	2012 Result	2013 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	2012	2013
Coastal	Fluoride	g.m ⁻³		1.3	1.3
	Total Cyanide	g.m ⁻³		<0.006	0.01
	Conductivity	µS/cm		51000	52490
	pH			8.1	8.4
	Dissolved Oxygen	mg/L	≥5	8.3	8
	% Saturation	%	>80	102	96.2
	Temperature	°C	<25	12.9	15
Control	Fluoride	g.m ⁻³		1.3	1.2
	Total Cyanide	g.m ⁻³		<0.006	<0.006
	Conductivity	µS/cm		51100	52500
	pH			8.1	8.5
	Dissolved Oxygen	mg/L	≥5	8.8	8.02
	% Saturation	%	>80	102	97.4
	Temperature	°C	<25	12.9	15
	Change to Temperature	°C	3	0	0

Condition of the diffuser

The Cathode Outfall Discharge Structure including the diffuser was inspected on 23rd November. 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. All discharge tubes were cleaned of growth and blockages removed.



Comments

All discharges of treated effluent were within permit limits during 2013.

Part K - Landfill Operations

Introduction

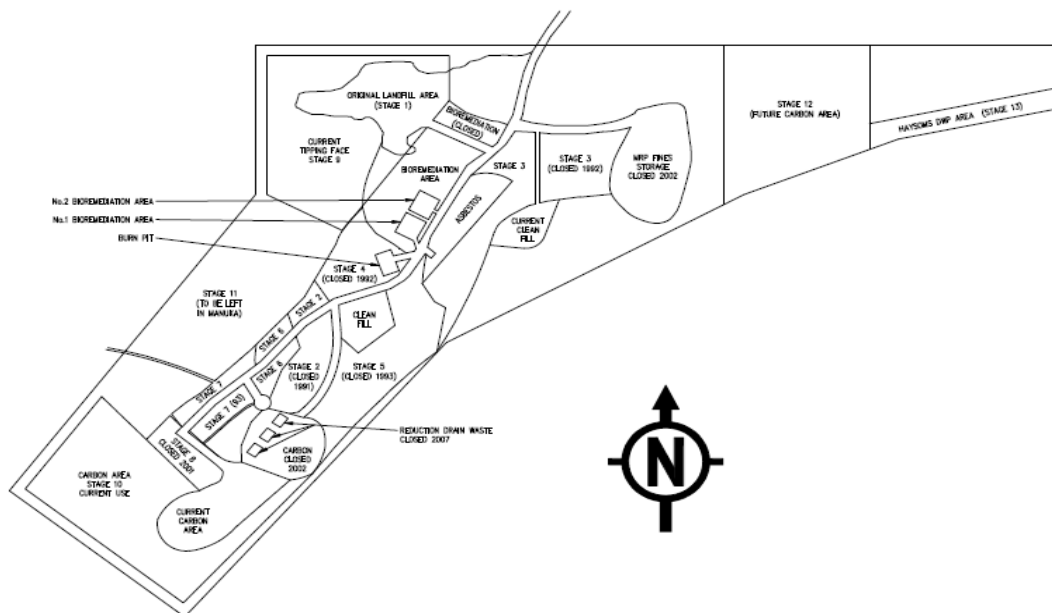
Operation of the landfill on the smelter's Tiwai Point property is covered by Discharge Permit No. 202196 issued by the Southland Regional Council on 8 December 2004.

The general operation of the on-site landfill is outlined in the NZAS Landfill Management Plan. Additional details on the proposed operations during 2014 are included in the following sections:

- proposed operation at the landfill for the next twelve months,
- comments on operations for 2013, and
- 2013 groundwater monitoring results.

Proposed Operation For 2014

The operation of the General waste, clean fill and MMMF areas will continue with no major changes proposed for 2014. Those areas have capacity for many years of future landfilling and do not requiring any structural changes within the next 12 months.



Current landfill disposal and storage areas.

Carbon Waste

The Stage Ten carbon dust tipping area was opened in 2002 and it is anticipated that there is capacity for landfill at current rate to at least the end of 2014. The carbon will be layered to the same height as the 2010 Lined Carbon area. Access into the carbon tipping area by truck is becoming problematic from a safety and environmental 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

General Waste

The general waste tip face is located at the South West corner heading in a Northerly direction, towards the general waste area access road. The general waste area was progressively capped with pea gravel as per the Landfill Management Plan.

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 continued in this area over 2013.

Metal Reclamation Plant Stockpile

The MRP area had intermittent trial loads of material trucked to the Taha plant for the aluminium to be extracted. Taha continued to experienced process problems during 2013 so full capacity has still not been achieved. Complete removal of dross from the MRP stockpile estimated to be completed within four to five years.

Carbon Dust Tipping Area

The boundary lines around the Carbon pile were pegged out during 2013 to ensure that the working face was not spilling over onto land not owned by NZAS. The quantity of carbon deposited in this area increased slightly during 2013 compared to previous years as it was identified that recycled carbon from some of the on-site dust collectors were contributing adversely to the purity level of the aluminium produced and had to be landfilled.

Timber Stockpile

From July 2013 all new waste wood generated was made available for staff and contractors to remove from site for firewood. This practice will continue indefinitely unless an alternative recycling route is made available. Recycling options for stock piled timber at the landfill is under investigation.

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.

Non-Process Waste

The results for non-classifiable waste are very variable from year to year. A figure of 900 tonnes was used for the average annual contribution from non-process waste reported in 2012 as that was the average of the previous 10 years. The non-process waste survey for 2013 estimated that 730 tonnes was deposited for the year. The main products deposited were clean fill materials like bricks, refractory and concrete.

In December 2013 Surveyors were engaged to perform UAV and photogrammetry of the NZAS landfill. This was to create a baseline for a future method to produce highly detailed orthometric photos as well as contour plans and calculate the volumes of the stockpiles for general waste, clean fill, carbon and dross deposited at the NZAS landfill. A repeat survey will be performed in December 2014 to estimate the volumes deposited during 2014.

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 2010 - 2013				
Material	2010	2011	2012	2013
Alumina	87	45	25	12
Carbon	2310	2147	2389	2320
Furnace Slag	154	164	171	283
Reject Bath	102	123	85	120
Resistor Coke	191	245	330	528
Miscellaneous	39	153	120	325
Total Process (tonnes)	2883	2877	3120	3588

The total amount of process waste in 2013 was slightly higher than seen in previous years. The increase is due to instability of the plant creating higher than usual amount of resistor coke, furnace slag and miscellaneous waste. Trials were carried out recycling less carbon streams to improve purity of metal produced. These trial were successful and going forward less carbon is now recycled back into the process. This will result in a higher tonnage of carbon material landfilled relative to the production of metal in the future.

Total Waste

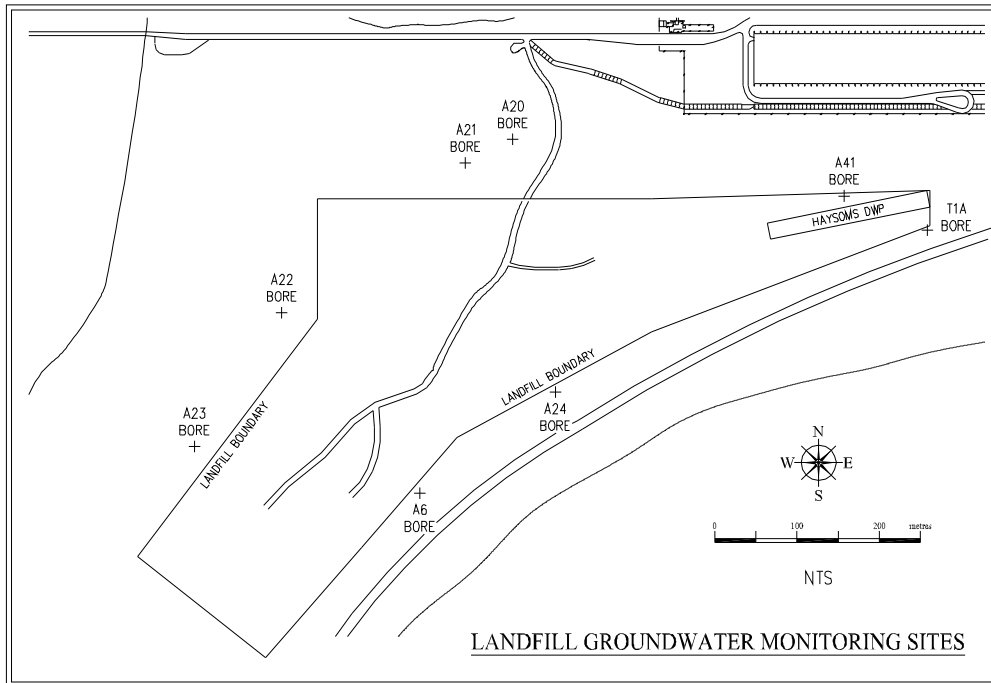
The total amount of waste sent to landfill is displayed in the table below.

Total Waste to the NZAS Landfill 2010 – 2013				
Material	2010	2011	2012	2013
Non-Process Waste	985	753	900	729
Process Waste	2883	2877	3120	3588
Total Waste (tonnes)	3868	3630	4020	4488

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 2012 and 2013. Bore A20 is located north of the landfill (upstream).

Analyte	Units	2012	2013	Range (since Commissioning)
		Average	Average	
Temperature	°C	N.D.	11.9	7.5 - 13.4
pH		5.85	5.9	5.1 - 7.2
Conductivity	µS/cm	973	887	644 - 1063
Alkalinity	g/m ³	22	32	8 - 240
Carbonaceous BOD5	g/m ³	1.00	1.00	<1 - 6
Total Nitrogen	g/m ³	0.97	1.23	0.1 - 1.68
Total Ammoniacal Nitrogen	g/m ³	0.16	0.20	0.02 - 0.34
Fluoride	g/m ³	0.81	1.13	0.03 - 11
Sulphate	g/m ³	46	40	25 - 55
Total Iron	g/m ³	5.95	3.56	0.46 - 26
Total Petroleum Hydrocarbons	g/m ³	N.D.	<1	<1 - 11.6
Total Kjeldahl Nitrogen	g/m ³	0.94	1.19	0.2 - 1.67
Nitrate Nitrogen	g/m ³	N.D.	0.062	<0.002 - 14
Nitrite Nitrogen	g/m ³	N.D.	0.007	<0.002 - 0.014
Weak Acid Dissociable Cyanide	g/m ³	N.D.	<0.001	<0.001 - 0.1
Boron	g/m ³	N.D.	0.052	0.032 - 0.067
Manganese	g/m ³	N.D.	0.128	0.111 - 0.394
Nickel	g/m ³	N.D.	0.0036	0.0018 - 0.01
Potassium	g/m ³	N.D.	3.9	2.9 - 4.1
Vanadium	g/m ³	N.D.	0.0026	<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 2012 and 2013. Bore A21 is located north of the landfill (upstream).

Analyte	Units	2012 Average	2013 Average	Range (since Commissioning)
Temperature	°C	N.D.	11.9	6.5 - 13.7
pH		6.2	5.85	5.1 - 6.9
Conductivity	µS/cm	838	1008	502 - 1723
Alkalinity	g/m ³	53	15	9 - 160
Carbonaceous BOD5	g/m ³	3.00	2	<1 - 16
Total Nitrogen	g/m ³	2.95	3.4	0.7 - 8
Total Ammoniacal Nitrogen	g/m ³	1.8	0.6	0.1 - 4.6
Fluoride	g/m ³	2.5	3.5	0.2 - 3.8
Sulphate	g/m ³	32	28	8 - 114
Total Iron	g/m ³	15.3	2.195	2.2 - 94.6
Naphthalene	mg/m ³	<1	<0.5	<0.1 - 1
Anthracene	mg/m ³	<0.4	<0.1	<0.02 - 0.2
Phenanthrene	mg/m ³	<0.4	<0.5	<0.005 - 0.2
Fluoranthene	mg/m ³	<0.4	<0.1	<0.02 - 0.2
Total Petroleum Hydrocarbons	g/m ³	N.D.	<1	<1 - 7.3
Total Kjeldahl Nitrogen	g/m ³	2.9	2.3	0.8 - 6.5
Nitrate Nitrogen	g/m ³	N.D.	1.86	0 - 29
Nitrite Nitrogen	g/m ³	N.D.	0.012	<0.002 - 0.028
Weak Acid Dissociable Cyanide	g/m ³	N.D.	0.00	<0.001 - 0.1
Boron	g/m ³	N.D.	0.102	0.07 - 0.154
Manganese	g/m ³	N.D.	0.097	0.064 - 0.473
Nickel	g/m ³	N.D.	0.0025	<0.0005 - 0.007
Potassium	g/m ³	N.D.	8	5 - 11
Vanadium	g/m ³	N.D.	0.00	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 2012 and 2013. Bore A41 is located north of the Hansoms' area (upstream).

Analyte	Units	2012 Average	2013 Average	Range (since Commissioning)
pH	-	6.55	6.45	5.9 - 7.9
Alkalinity	g/m ³	58	25	11.1 - 170
Temperature	°C	N.D.	12.7	5.9 - 7.9
Conductivity	µS/cm	586	386	282 - 984
Carbonaceous BOD ₅	g/m ³	1	1	0.5 - 1
Fluoride	g/m ³	3.7	1.0	0.25 - 5
Sulphate	g/m ³	26	23	19.2 - 47
Total Iron	g/m ³	0.05	0.12	0.04 - 0.63
Boron	g/m ³	N.D.	0.12	0.04 - 4.1
Manganese	g/m ³	N.D.	<0.01	<0.01 - 0.023
Potassium	g/m ³	N.D.	1.21	0.27 - 4.8
Vanadium	g/m ³	N.D.	<0.002	<0.002 - 0.011
Nickel	g/m ³	N.D.	0	0.0005 - 0.004
Ammoniacal-Nitrogen	g/m ³	0.01	<0.01	0.005 - 0.16
Total Nitrogen	g/m ³	7	1	0.39 - 26
Total Kjeldahl Nitrogen	g/m ³	0.61	0.505	0.28 - 3.1
Nitrate Nitrogen	g/m ³	N.D.	0.34	0.269 - 23
Nitrite Nitrogen	g/m ³	N.D.	<0.002	<0.002 - 0.2
Total Petroleum Hydrocarbons	g/m ³	N.D.	<1	<1
Weak Acid Dissociable Cyanide	g/m ³	N.D.	0	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 2012 and 2013. Bore A22 is located west of the landfill.

Analyte	Units	2012 Average	2013 Average	Range (since Commissioning)
Temperature	°C	N.D.	11.4	8.6 - 12.1
pH		4.95	5.2	4.2 - 7.3
Conductivity	µS/cm	555	478	354 - 1204
Alkalinity	g/m ³	10	34	1 - 294
Carbonaceous BOD5	g/m ³	6	5	<1 - 15
Total Nitrogen	g/m ³	6.9	6.85	0.42 - 8.1
Total Ammoniacal Nitrogen	g/m ³	1.61	1.94	0.01 - 2.3
Fluoride	g/m ³	3.1	3.4	0.03 - 4
Sulphate	g/m ³	3	5	0 - 165
Total Iron	g/m ³	1.995	2.6	0.59 - 3.45
Total Petroleum Hydrocarbons	g/m ³	N.D.	<1	<1 - 3.45
Total Kjeldahl Nitrogen	g/m ³	6.8	6.8	0.9 - 8
Nitrate Nitrogen	g/m ³	N.D.	0.10	<0.02 - 0.2
Nitrite Nitrogen	g/m ³	N.D.	0.1	<0.002 - 0.13
Weak Acid Dissociable Cyanide	g/m ³	N.D.	0.0012	<0.001 - 0.1
Boron	g/m ³	N.D.	0.071	0.006 - 0.071
Manganese	g/m ³	N.D.	0.031	0.0049 - 0.394
Nickel	g/m ³	N.D.	0.0032	0.0007 - 0.01
Potassium	g/m ³	N.D.	5.1	1.65 - 5.3
Vanadium	g/m ³	N.D.	0.0066	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 2012 and 2013. Bore A23 is located west of the landfill.

Analyte	Units	2012	2013	Range (since Commissioning)
		Average	Average	
Temperature	°C	N.D.	11.5	9 - 12.5
pH		5.85	5.85	5.4 - 6.4
Conductivity	µS/cm	472	446	378 - 745
Alkalinity	g/m ³	32	33	31 - 60
Carbonaceous BOD5	g/m ³	1.00	1	<1 - 5
Total Nitrogen	g/m ³	1.835	1.915	0.88 - 2.7
Total Ammoniacal Nitrogen	g/m ³	0.9	1.06	0.05 - 1.4
Fluoride	g/m ³	0.1	0.1	<0.1 - 0.36
Sulphate	g/m ³	0.25	0.95	0.25 - 30
Total Iron	g/m ³	5.0	4.95	2.6 - 13
Total Petroleum Hydrocarbons	g/m ³	N.D.	<1	<1 - 7.2
Total Kjeldahl Nitrogen	g/m ³	1.8	1.915	1.1 - 2.3
Nitrate Nitrogen	g/m ³	N.D.	<0.02	<0.02 - 0.05
Nitrite Nitrogen	g/m ³	N.D.	<0.02	<0.02 - 0.019
Weak Acid Dissociable Cyanide	g/m ³	N.D.	<0.001	<0.001 - 0.1
Boron	g/m ³	N.D.	0.05	0.04 - 0.05
Manganese	g/m ³	N.D.	0.078	0.05 - 0.12
Nickel	g/m ³	N.D.	0.0098	<0.0005 - 0.0016
Potassium	g/m ³	N.D.	4	4 - 5
Vanadium	g/m ³	N.D.	0.012	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 2012 and 2013. Bore A24 is located south east of the landfill.

Analyte	Units	2012 Average	2013 Average	Range (since Commissioning)
Temperature	°C	N.D.	11.1	9.4 - 12.8
pH		8.5	8.5	6.9 - 8.7
Conductivity	µS/cm	4140	2820	447 - 7290
Alkalinity	g/m ³	904	1015	108 - 2600
Carbonaceous BOD5	g/m ³	64	25	2 - 120
Total Nitrogen	g/m ³	233	179	16.8 - 560
Total Ammoniacal Nitrogen	g/m ³	188	153	28.2 - 450
Fluoride	g/m ³	93	78	<0.1 - 120
Sulphate	g/m ³	22	88	0 - 312
Total Iron	g/m ³	30	22	8.2 - 60
Naphthalene	mg/m ³	59	180	0.06 - 510
Anthracene	mg/m ³	<0.3	0.35	<0.3 - 1.2
Phenanthrene	mg/m ³	0.6	2.1	<0.3 - 4.9
Fluoranthene	mg/m ³	<0.3	0.555	<0.3 - 1
Total Petroleum Hydrocarbons	g/m ³	N.D.	3.7	<1 - 18.6
Total Kjeldahl Nitrogen	g/m ³	255	173	63 - 560
Nitrate Nitrogen	g/m ³	N.D.	1	0.05 - 33
Nitrite Nitrogen	g/m ³	N.D.	1	0.01 - 1.3
Weak Acid Dissociable Cyanide	g/m ³	N.D.	<0.01	<0.01 - 0.1
Boron	g/m ³	N.D.	9.7	4.1 - 17
Manganese	g/m ³	N.D.	0.084	0.084 - 0.22
Nickel	g/m ³	N.D.	0.02	0.004 - 0.05
Potassium	g/m ³	N.D.	46	11 - 79
Vanadium	g/m ³	N.D.	1	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 2012 and 2013. Bore A6 is located south east of the landfill.

Analyte	Units	2012	2013	Range (since Commissioning)
		Average	Average	
Temperature	°C	N.D.	12.7	10.3 - 13.5
pH		6.8	7.0	5.8 - 7.6
Conductivity	µS/cm	2625	2605	158 - 5689
Alkalinity	g/m ³	645	575	280 - 943
Carbonaceous BOD5	g/m ³	3	3	1 - 6
Total Nitrogen	g/m ³	20	17	9.7 - 47.4
Total Ammoniacal Nitrogen	g/m ³	10	10	0.15 - 34.7
Fluoride	g/m ³	60	57	2 - 104
Sulphate	g/m ³	660	650	480 - 2050
Total Iron	g/m ³	27	25	4.2 - 40
Naphthalene	mg/m ³	<2	4.00	<0.1 - 3
Anthracene	mg/m ³	<0.4	<0.4	0.05 - 1.34
Phenanthrene	mg/m ³	<0.4	<0.4	<0.05 - 0.2
Fluoranthene	mg/m ³	<0.4	<0.4	<0.01 - 0.2
Total Petroleum Hydrocarbons	g/m ³	N.D.	<1	<1 - 9.2
Total Kjeldahl Nitrogen	g/m ³	20	17	14.2 - 48
Nitrate Nitrogen	g/m ³	N.D.	0.10	0.001 - 14
Nitrite Nitrogen	g/m ³	N.D.	0.20	0.004 - 0.218
Weak Acid Dissociable Cyanide	g/m ³	N.D.	0.0019	0.0018 - 0.1
Boron	g/m ³	N.D.	0.69	0.66 - 2.54
Manganese	g/m ³	N.D.	1.13	0.22 - 1.85
Nickel	g/m ³	N.D.	0.0041	0.0041 - 0.022
Potassium	g/m ³	N.D.	11	11.1 - 37
Vanadium	g/m ³	N.D.	0.14	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 2012 and 2013. Bore T1A is located south east of the Haysoms DWP area.

Analyte	Units	2012	2013	Range (since Commissioning)
		Average	Average	
pH	-	8.85	7.8	6.8 - 9.6
Alkalinity	g/m ³	333.5	228.5	108 - 2110
Temperature	°C	N.D.	12.7	10.6 - 13.7
Conductivity	µS/cm	1416	1154	473 - 8930
Carbonaceous BOD ₅	g/m ³	1	1	<1 - 10
Fluoride	g/m ³	31	21	<0.1 - 210
Sulphate	g/m ³	26	34	17.4 - 338
Total Iron	g/m ³	0.2	0.18	0.01 - 15.3
Boron	g/m ³	N.D.	5.1	0.05 - 12.6
Manganese	g/m ³	N.D.	0.05	0.0006 - 0.253
Potassium	g/m ³	N.D.	21	2.44 - 69.1
Vanadium	g/m ³	N.D.	0.19	<0.01 - 0.34
Nickel	g/m ³	N.D.	<0.01	<0.0005 - 0.044
Ammoniacal-Nitrogen	g/m ³	32	26.75	<0.01 - 580
Total Nitrogen	g/m ³	89	64	1.5 - 783
Total Kjeldahl Nitrogen	g/m ³	33	28	0.4 - 630
Nitrate Nitrogen	g/m ³	N.D.	44	1.25 - 229
Nitrite Nitrogen	g/m ³	N.D.	4.8	0.003 - 20.8
Total Petroleum Hydrocarbons	g/m ³	N.D.	<1	<1
Weak Acid Dissociable Cyanide	g/m ³	N.D.	0.02	<0.001 - 0.325

N.D: Not analysed – only required biennially.

Landfill Groundwater Monitoring, Continued

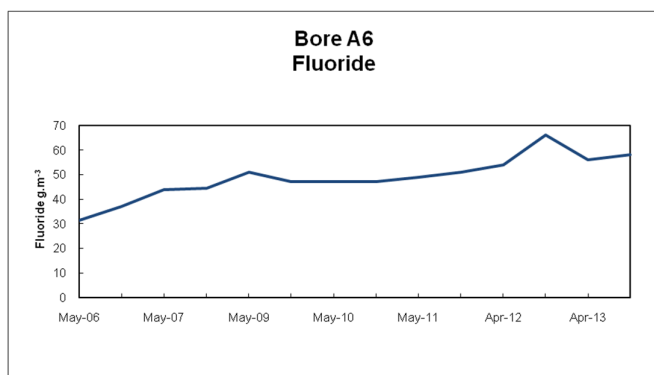
Comments

Several of the Landfill bores, are showing increasing trends in analyte concentrations with bore A24 showing a spike in sulphate concentration in the second survey. The 1st survey for 2013 was carried out in April and the 2nd in October.

Shown below are the bores, which showed significant changes or trends in analyte concentrations in 2013.

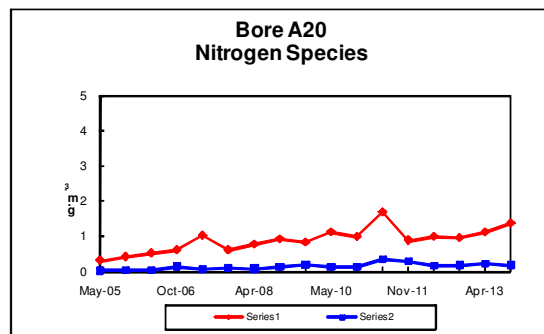
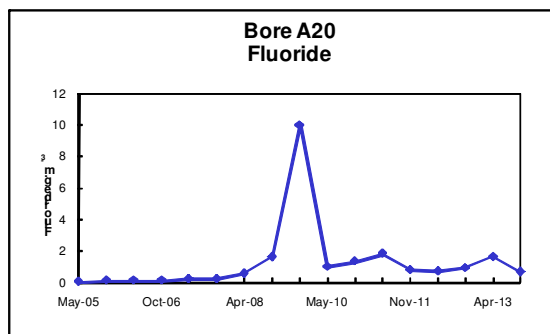
Bore A6

Bore A6, south-east of the landfill (downstream) is showing a slow increasing trend in fluoride concentration.



Bore A20

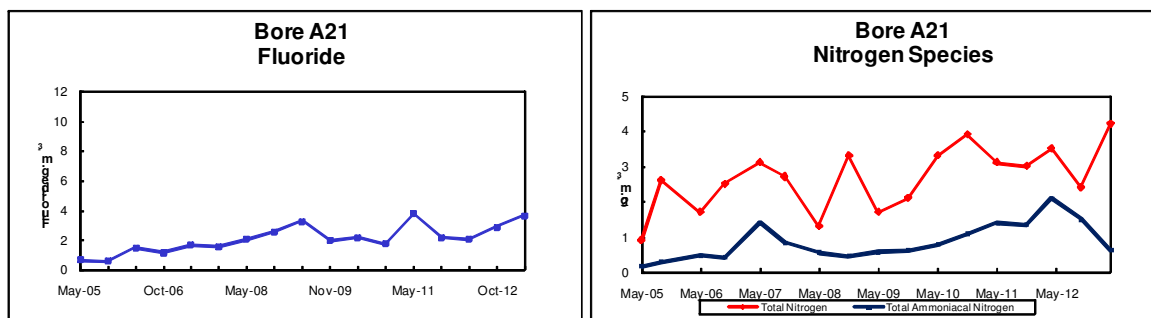
Bore A20 is upstream of the landfill but appears to be showing minor leachate influence.



Landfill Groundwater Monitoring, Continued

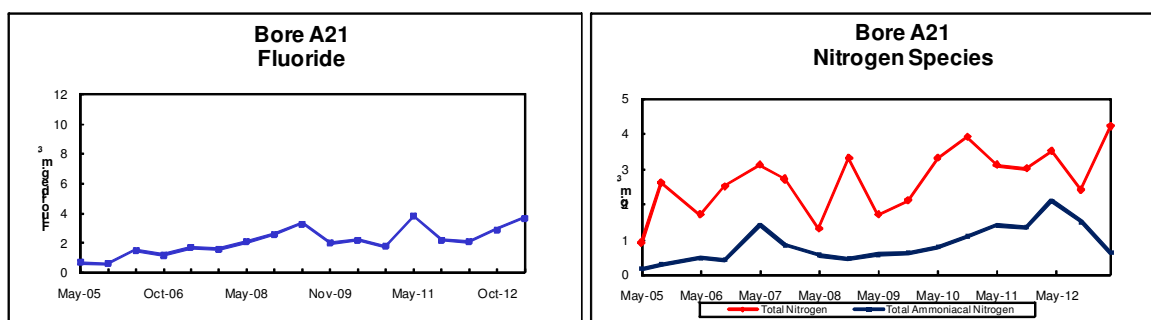
Bore A21

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



Bore A22

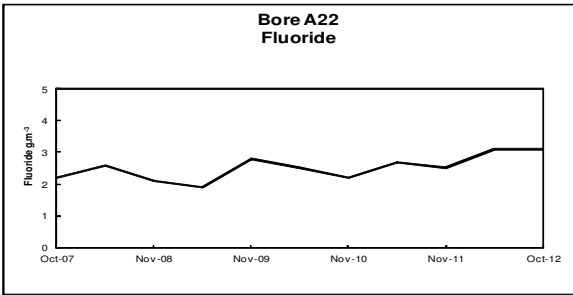
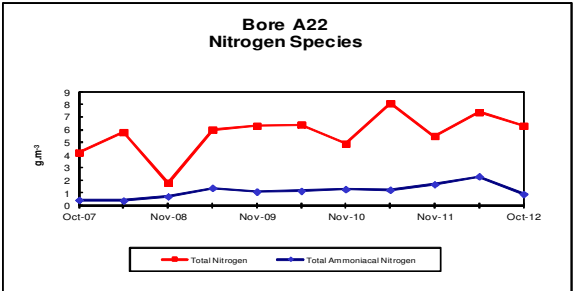
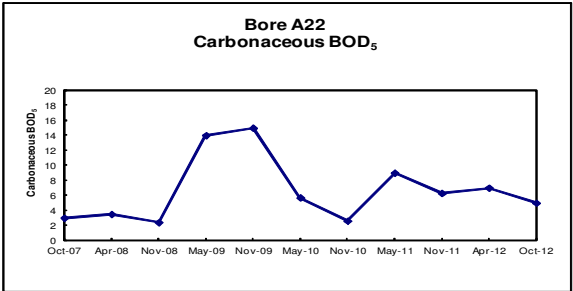
Bore A22, west of the landfill is also showing a slow increasing trend in fluoride and nitrogen species.



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 2013 showed similar levels to 2012.

Spent Cell Lining Storage Shed

Monitoring of the membranes under the Spent Cell Lining storage shed continued during 2013. 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

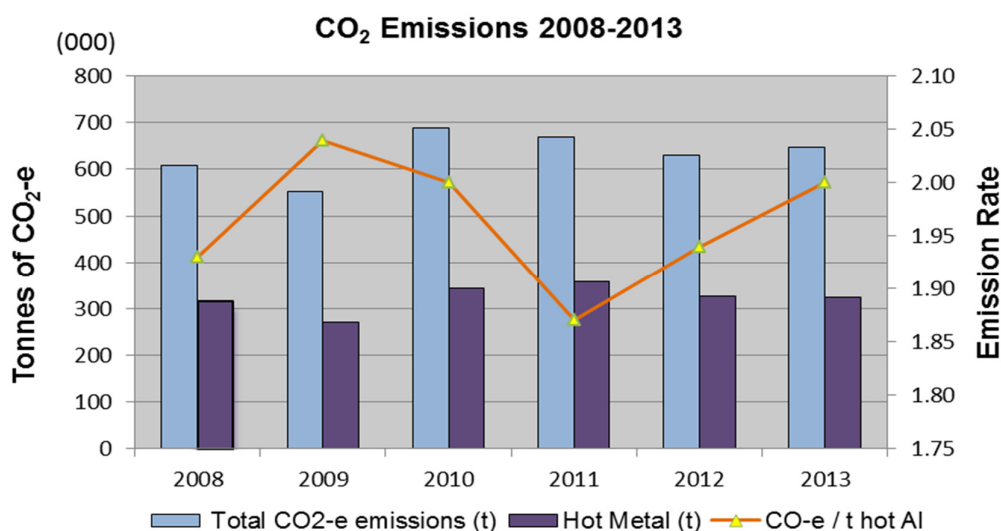
Introduction

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 financial constraints. Line 4 was not operating for most of the year and further cells were removed from operation on other Reduction lines.

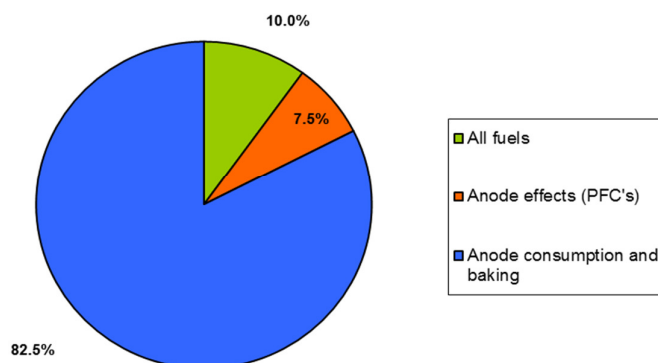
Carbon Dioxide - 2013

The total calculated carbon dioxide equivalent (CO₂-e) discharge from NZAS during the year ending 31 December 2013 was 640,577 tonnes. This was 12,121 tonnes more CO₂-e than last year and with metal production decreased by 32,143 tonnes. The emission rate in 2013 was 2.00 t CO₂-e / per tonne of aluminium produced, which is within the range of results achieved over the last 6 years.



The total calculated CO₂ equivalents are emitted from carbon consumption (anodes), perfluorocarbons generation (PFCs) and fuel usage. This is a similar percentage distribution to previous years.

2013 NZAS Greenhouse Gas Profile



Greenhouse Gas Discharges, Continued

Anodes – 2013

82.5% of the total CO₂ 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 2013, which kept the anode consumption at a favourable level.

Perfluorocarbons – 2013

Perfluorocarbons (PFCs) contribute to climate change in the same way that CO₂ does. PFCs are gases emitted from the aluminium production process when conditions in the cells become unstable. From April 2013 an increase in the instability of cells was observed and this problem is currently under investigation with improvement actions implemented to resolve the issue. The percentage of PFC's emitted as CO₂ equivalent out of the total greenhouse gas emission was 7.5%.

New increased Global Warming Potentials (GWP) for CF₄ and C₂F₆ for converting PFC gases to CO_{2e} were introduced in 2013 through the New Zealand Emission Trading Scheme, increasing the reported total PFC emissions from NZAS by approximately 18%. With this change and the deterioration of the process the total calculated PFCs discharged from NZAS during 2013 increased by 20% compared to 2012 despite a small drop in metal production.

Fuel – 2013

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 CO₂ equivalents from fuels decreased slightly during 2013. The rebuild of carbon baking furnace 4 was completed during 2013. The greenhouse gas contribution from fuels is stable at about 10% of the total emissions.

End of Report for 2013