



New Zealand Aluminium Smelters Limited

Interdepartmental

Committee

Report

2002

REPORT TO THE INTERDEPARTMENTAL COMMITTEE ON ENVIRONMENTAL EFFECTS OF THE TIWAI ALUMINIUM SMELTER FOR THE YEAR ENDING 31 DECEMBER 2002

MEETING AT TIWAI 29 April 2002 at 1.30pm

THE INFORMATION CONTAINED IN THIS REPORT IS CONFIDENTIAL TO THE MEMBERS OF THE INTERDEPARTMENTAL COMMITTEE

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2002 IDC Report

Summary

Main stack discharges to air were within permit standards during 2002.

November and December saw an increase in discharge of Total Particulate. This was due to broken bags in the dry scrubbing system. A program of dry scrubber bag replacement is planned for early 2003.

The Total average condensable hydrocarbons and the 16 USEPA polycyclic aromatic hydrocarbons levels measured in November 2002 showed an increase from those measured in 2001.

Potline Roof Louvres

Potline roof louvre discharges were within permit standards during 2002.

The new flows and factors as per 1999 Potline Roof louvre Airflow and Discharge Report were applied from January 2002. The 2002 data has shown a step change downward as a result of this change.

Dispersion

Wind speeds were generally similar to 2001. Monthly rainfall for 2002 was above average for most of the year.

Ambient Air

Ambient air gaseous and particulate fluoride concentrations during 2002 showed a decrease on those reported for 2001 for the 1km Hut and the No. 1 Bore site but still well within permit standards.

Atmospheric Deposition

All permit guidelines were met during 2002.

Vegetation

The fluoride concentrations of ungrazed grass close to the smelter were similar to the concentrations measured in 2001.

Fluoride in Pinus radiata needles were within permit guidelines during 2002.

The fluoride concentrations of grazed grass for all monitoring farms and cattle urine and cattle bone on GMF4 were within permit standards during 2002 and similar to previous years.

Summary, Continued

Liquid Discharges

Discharges from the North drain and of treated effluent and their effect on the environment were within permit standards during 2002.

Two violations were recorded for the West drain during 2002. On both occasions the natural colour and clarity of the receiving seawater was changed to a conspicuous extent by discharges from the drain. On one-occasion results for the South Drain showed a difference in pH greater than 0.1 pH units. It was not considered that this difference was caused by any discharges from the smelter.

The 2002 average free cyanide concentration measured in the treated effluent is similar to those measured during 2001.

Landfill

Monitoring of groundwater near the NZAS landfill during 2002 generally indicated similar results to 2001. Bores located downstream of the landfill face are showing fluctuating concentrations of fluoride indicating the proximity of the bore to the MRP fines storage area.

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Introduction

This report outlines NZAS' commitment to maintaining and where possible improving the smelter's environmental performance.

This report includes some of the annual reports forwarded to Environment Southland each year with additional sections including discharges to air, dispersion conditions, liquid discharges etc. included to cover NZAS' discharges to, and effects on, the environment.

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

ISO14001 Accreditation

NZAS has been audited for compliance to ISO 14001 by business certification group, NCSI (Australia) and has been awarded accreditation. This marks a major milestone and achievement for NZAS and provides a system and structure for environmental management and environmental improvement

The Environmental Management System upon which the accreditation is based forms the foundations for continuous improvement in this area - a fundamental requirement of ISO 14001 accreditation. Ideas from our annual action planning are recorded in our tracking database for reporting and auditing. Each department has set targets and generated ideas for specific environmental improvements supporting the broader corporate and site initiatives.

ISO17025 Accreditation

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

In addition, the Laboratory has maintained accreditation to ISO 17025 "General Competence of Calibration and Testing Laboratories". The scope of the accreditation includes Quality Systems to ensure the accuracy of data. In 2002 the Laboratory requested an extension to the scope of accreditation to include the sampling of vegetation, waters and ambient air. An audit of compliance was completed by independent experts (International Accreditation New Zealand) in December 2002. Formal notification for the extension of the accreditation is expected in March 2003.

2002 IDC Report

Environmental Incidents

There were three significant environmental incidents that were reported to Environment Southland in 2002.

In May and September the seawater at discharge point of West Drain contained a large amount of visible carbon material. The discharge was caused by a prior heavy rain event that flushed fine carbon material lying on outside hard surfaces through the drainage system to sea. Corrective actions in the Carbon Plant were implemented to minimise operations conducted on outside areas that contribute to the availability of carbon material to enter the drainage system.

A further incident occurred in September. An excavator was operating on the southeast side of the SCL building when a hydraulic coupling parted resulting in an estimated 130 litres of oil escaping onto the gravel underneath the excavator. The site oil spill containment procedure was implemented immediately. The containment sand and some surface gravel, was then removed to the bioremediation area at the Landfill. There are no drains in the vicinity of where this incident occurred.

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Discharges into Air

Introduction

Discharges into air from the smelter and wharf are covered by Air Discharge Permit Number 93566. The permit conditions were revised following NZAS' application to change or cancel some conditions, which was approved by the Southland Regional Council on 5 August 1998.

This Chapter covers:

- Main Stack Discharges,
- Potline roof louvre discharges,
- Fluoride discharges into air,
- Baghouse discharges,
- Main Stack plume opacity, and
- Sulphur contents of raw materials and fuels used in the aluminium smelting process.

Main Stack Discharges

Monitoring results

The following table shows the average main stack monitoring results for 2002. The averages are equivalent to the 12 month running average for the period ending December 2002.

		Running 12 month average			
Parameter	Units	Standard	2002 Result	Maximum for any month	
Gas flow rate	Sm ³ / min	-	60,600	-	
Total particulate	kg/min	3.25	0.92	3.05	
Gaseous fluoride	kg/min	0.65	0.14	0.18	
Particulate fluoride	kg/min	1.94	0.01	0.05	
Sulphur dioxide	kg/min	-	11.6	12.6	
Total condensable hydrocarbons	kg/min	-	0.47	-	
Polycyclic aromatic hydrocarbons	kg/min	-	0.07	-	

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Total particulate

Standard: 12 month running average not to exceed 3.25 kg/min.

The following graph show both the average monthly and 12 monthly running average main stack total particulate discharge during 2001 and 2002.



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



Discharges to Air

Gaseous fluoride

Standard: 12 month running average not to exceed 0.65 kg/min.

The following graph show both the average monthly and 12 monthly running average main stack gaseous fluoride discharge during 2001 and 2002.



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



Discharges to Air

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Particulate fluoride

Standard: 12 month running average not to exceed 1.94 kg/min.

The following graph shows both the average monthly, and the 12 monthly running average main stack particulate fluoride discharge during 2001 and 2002.



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



Discharges to Air

Sulphur Dioxide

The following graph shows both the average monthly and 12 monthly running average main stack sulphur dioxide discharge during 2001 and 2002.



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



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Total Condensable Hydrocarbons and Polycyclic Aromatic Hydrocarbons

The annual analysis for Total condensable hydrocarbons and 16 priority USEPA PAH was carried out during November 2002. The following graph shows the annual Total Condensable hydrocarbons discharges.



The following graph shows the annual result for 16 Priority USEPA polycyclic hydrocarbons.



Discharges to Air

Comments

Discharges of total particulate, gaseous fluoride and particulate fluoride from the main stack were within the permit standards throughout 2002.

During November and December 2002 the Total particulate showed an increase. This increase was attributed to broken bags in the dry scrubbing system.

During most of 2002 due to power constraints NZAS had on average of 30 cells not operating. Most cells were re-commissioned from November.

The average Total condensable hydrocarbons and the 16 USEPA PAH level measured in November 2002 showed an increase from those measured in 2001. The reported figure is an average of data from seven tests. This average is influenced by one very high result in the survey. No evidence could be attributed to this high test result not being valid, as all experimental and operational conditions were normal throughout the test. There were no operational changes during 2002, which would account for the increase in Total condensable hydrocarbons.

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Potline Roof Louvre Discharges

Monitoring results

The table below shows the Potline roof louvre monitoring results for 2002. The permit standards are for 12 month running averages.

		Running 12 month average			
Parameter	Units	Standard	2002 Result	Maximum for any month	
Total particulate	kg/min	3.05	0.87	1.14	
Gaseous fluoride	kg/min	0.38	0.10	0.13	
Particulate fluoride	kg/min	0.38	0.13	0.16	
Sulphur dioxide	kg/min	-	0.25	0.39	

Discharges to Air

Total particulate

Standard: 12 month running average not to exceed 3.05 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre total particulate discharge during 2001 and 2002.



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



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Gaseous fluoride

Standard: 12 month running average not to exceed 0.38 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre gaseous fluoride discharge during 2001 and 2002.



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



Discharges to Air

Particulate fluoride

Standard: 12 month running average not to exceed 0.38 kg/min.

The following graph shows both the average monthly and 12 month running Potline roof louvre particulate fluoride discharge during 2001 and 2002.



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



Sulphur dioxide

The following graph shows both the average monthly and 12 month running Potline roof louvre sulphur dioxide discharge during 2001 and 2002.



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



Discharges to Air

Comments

The discharge of total particulate, particulate fluoride and gaseous fluoride from the Potline roof louvres was within permit standards.

For most of 2002, due to the electricity shortage, NZAS was operating under power constraints. During this time NZAS had on average of 30 cells not operating. Cells were re-commissioned from November.

As detailed in last years report new flow data, and coefficient factors, for the Potline roof louvres were applied from January 2002. The new flow is 593 900 m³/min compared to the previous flow of 853 800 m³/min. The 2002 data has shown a step change downward as a result of this change.

Sulphur discharges are limited by the sulphur content of the raw materials. See page DA18.

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Fluoride Discharges

Performance data

The table below shows the fluoride discharges expressed as a ratio of hot aluminium metal production during 2002.

Parameter	Units	2002 Result	Maximum for any month	
Main Stack				
Gaseous fluoride	kg/t Al	0.22	0.28	
• Particulate fluoride	kg/t Al	0.02	0.07	
• Total fluoride	kg/t Al	0.24	0.30	
Reduction Line Roof Louvres				
Gaseous fluoride	kg/t Al	0.16	0.21	
Particulate fluoride	kg/t Al	0.21	0.25	
• Total fluoride	kg/t Al	0.37	0.44	
Plant				
Gaseous fluoride	kg/t Al	0.38	0.45	
Particulate fluoride	kg/t Al	0.23	0.31	
• Total fluoride	kg/t Al	0.61	0.72	

The following graph shows the monthly main stack fluoride per tonne aluminium discharge during 2001 and 2002.



Discharges to Air

Fluoride Discharges, Continued

Performance data, Continued

The following graph shows the average monthly Potline roof louvre fluoride per tonne aluminium discharge during 2001 and 2002.



The following graph shows the average total plant fluoride per tonne aluminium during 2001 and 2002.



Comments

The fluoride discharge rate from the plant showed a slight decrease during 2002 due to the step change downward in Potline roof louvre data.

Discharges to Air

27 March, 2003

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Baghouse Discharges

The regular inspection of the baghouse discharges continued during 2002. These inspections were in addition to the on-going operational surveillance of this equipment. Monthly inspections across these dust collectors reported emissions (using the six-point observation scale) to be on average between 0 and 1, a score of 1 being "barely discernible emissions", with a maximum of a 3.

Main Stack Plume Opacity

Main Stack plume opacity is determined by visual observations using the standard Ringleman chart. The following graph summarises the observations recorded during 2002.



There has been an increase in the number of observations of a Ringleman number of 1.5 and 2 categories during 2002.

Sulphur Content of Raw Materials and Fuels

Material	Units	Permit Maximum	2002 Annual Average	2002 Maximum	2002 Minimum
Petroleum Coke	%	3.0	2.48	2.75	2.25
Pitch	%	1.0	0.44	0.45	0.43
Heavy Fuel Oil	%	3.5	2.08	2.49	1.77

The following table shows the maximum, minimum, and average sulphur content of raw materials and fuels delivered to the smelter during 2002.

Comments

All shipments of raw materials and fuels during the 2002 met permit standards for sulphur contents.

The average sulphur content of the raw materials and fuels during 2002 was less than or similar to that reported in 2001.

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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 2002 wind pattern was dominated by westerly, north-westerly and south-westerly winds.

The following table shows the predominant winds and total rainfall recorded for each month during 2002.

Month	Predominant Wind Direction	Rainfall (mm)
January	East, west and south-west	36
February	South, east, and west	84
March	West and north-west	168
April	West, north-west and south-west	74
May	West, and south-west	118
June	West, north-west, and south-west	141
July	East, north and west	36
August	West, north-west, and south-west	92
September	West, and north west	140
October	West, south-west and north-west	157
November	West, south west and south	123
December	West, north-west, and south-west	152

Meteorological Conditions, Continued



Dispersion Conditions

Ambient Air

Introduction

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

Permit Standards

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

٠	24 hour average	$2.0 \ \mu g/m^3$
٠	7 day average	$1.0 \ \mu g/m^3$
٠	One month average	$0.5 \ \mu g/m^3$

The 24-hour average is not to be exceeded on more than eight days in any twelve consecutive months.

The standards apply to measurements on land off Tiwai Peninsula and on Tiwai Peninsula east of Comalco New Zealand Ltd's freehold land.

At sites other than 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 μ g/m³.

Site Locations

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



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Ambient Air at 1 Kilometre Hut

Monitoring results

F) tonne disch werease mit ambreat of f appeared to decrease decrease insignificant? decrease insignificant? The following table summarises the monitoring results during 2001 and 2002. The sampling frequency for ambient air fluoride at this site is seven days.

Parameter	Units	Standard	2001	2002
Gaseous Fluoride Concentration		-		
• Max 7 day average	$\mu g/m^3$	-	1.10	0.90
 Max monthly average 	$\mu g/m^3$	-	0.60	0.50
Annual average	$\mu g/m^3$	-	0.28	0.28
Particulate fluoride concentration		~		
• Max 7 day average	$\mu g/m^3$	-	0.40	0.30
 Max monthly average 	$\mu g/m^3$	=	0.20	0.20
 Annual average 	$\mu g/m^3$	-	< 0.1	< 0.1

Gaseous fluoride

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





Ambient Air

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 μ g/m³ are plotted as 0.05 μ g/m³

Comments

The levels are at similar levels to those reported in 2001.

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Ambient Air at Other Sites on Tiwai Peninsula

Monitoring results

The following table summarises the monitoring results during 2001 and 2002 for the two other sites located on Tiwai Peninsula.

Site	Parameter	Units	Standard	2001	2002
No. 1 Bore	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu g/m^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu g/m^3$	0.5	0.20	0.10
	Annual average	$\mu g/m^3$		< 0.1	< 0.1
	Particulate Fluoride concentration				
	• Max 7 day average	$\mu g/m^3$		N.D.	N.D.
	Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	Annual average	$\mu g/m^3$		< 0.1	< 0.1
No. 6 Bore	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu g/m^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu g/m^3$	0.5	< 0.1	< 0.1
	Annual average	$\mu g/m^3$		< 0.1	< 0.1
	Particulate Fluoride concentration				
	• Max 7 day average	$\mu g/m^3$		N.D.	N.D.
	Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	Annual average	$\mu g/m^3$		< 0.1	< 0.1

N.D: Not Done

Comments

Gaseous and particulate fluoride concentrations were close to or below the detection limit of the Australian standard (AS 3580.1991) method at these sites and were within the permit standards throughout 2002. The maximum monthly average of $0.1 \mu g/m^3$ at No. 1 Bore site occurred in December. Winds during the month ranged from light to strong mainly from the west, which may have influenced the concentration measured at this site.

Ambient Air at Sites off Tiwai Peninsula

Monitoring results

The following table summarises the monitoring results during 2001 and 2002 for the three ambient air-monitoring sites located off Tiwai Peninsula.

Site	Parameter	Units	Standard	2001	2002
Buddle				-	
Road	Gaseous Fluoride Concentration				
	• Max 7 day average	μg/m ³	1.0	N.D.	N.D.
	• Max monthly average	$\mu g/m^3$	0.5	< 0.1	< 0.1
	• Annual average	$\mu g/m^3$		< 0.1	< 0.1
	Particulate Fluoride concentration				
	• Max 7 day average	µg/m ³		N.D.	N.D.
	• Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	Annual average	$\mu g/m^3$		< 0.1	< 0.1
Waituna	Gaseous Fluoride Concentration	_			
	• Max 7 day average	$\mu g/m^3$	1.0	N.D.	N.D.
	• Max monthly average	µg/m ³	0.5	< 0.1	< 0.1
	Annual averge	$\mu g/m^3$		< 0.1	< 0.1
	Particulate Fluoride concentration				
	• Max 7 day average	$\mu g/m^3$		N.D.	N.D.
	• Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	Annual average	$\mu g/m^3$		< 0.1	< 0.1
Bluff	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu g/m^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu g/m^3$	0.5	< 0.1	< 0.1
	Annual averge	$\mu g/m^3$		< 0.1	< 0.1
	Particulate fluoride concentration				
	• Max 7 day average	$\mu g/m^3$		N.D.	N.D.
	• Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	Annual average	$\mu g/m^3$		< 0.1	< 0.1

N.D: Not Done.

Comments

All permit standards were met at the three sites off Tiwai Peninsula throughout 2002.

All gaseous and particulate fluoride concentrations were below the detection limit of the Australian Standard method at these sites during 2002.

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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
Reactive Aluminium		
• Aesthetic highest desirable	g.m ⁻³	0.05
• Aesthetic excessive	g.m ⁻³	0.20

Site Locations

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



Atmospheric Deposition
Atmospheric Deposition Monitoring Results

Fluoride Deposition

The fluoride atmospheric deposition during 2002 is summarised in the following table.

Site	Units	2002 average	Maximum for any month	Minimum for any month
D2. No.1 Bore ¹	g.m ⁻³	0.21	0.41	0.06
D12 TEF2 ¹	g.m ⁻³	0.05	0.12	<0.05
D6 Buddle Road	g.m ⁻³	<0.05	0.09	<0.05
D7 Gibson's Farm	g.m ⁻³	< 0.05	0.07	<0.05
D8 Bluff	g.m ⁻³	<0.05	0.10	<0.05
D9 Awarua Bay Road	g.m ⁻³	< 0.05	0.06	< 0.05
D11 Marshall Road	g.m ⁻³	< 0.05	<0.05	< 0.05

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

Reactive Aluminium Deposition

The reactive aluminium atmospheric deposition during 2002 is summarised in the following table.

	Site	Units	2002 average	Maximum for any month	Minimum for any month
D2. No.	.1 Bore ¹	g.m ⁻³	0.05	0.14	< 0.03
D12 TEI	F2 ¹	g.m ⁻³	<0.03	<0.03	< 0.03
D6 Buc	ddle Road	g.m ⁻³	<0.03	<0.03	<0.03
D7 Gib	oson's Farm	g.m ⁻³	<0.03	<0.03	<0.03
D8 Blu	ıff	g.m ⁻³	<0.03	<0.03	<0.03
D9 Aw	arua Bay Road	g.m ⁻³	< 0.03	<0.03	< 0.03
D11 Ma	rshall Road	g.m ⁻³	< 0.03	<0.03	<0.03

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

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Atmospheric Deposition Monitoring Results, Continued

Comments

All permit guidelines were met during 2002. Fluoride and reactive aluminium deposition during 2002 was generally within the normal range of results since the commissioning of the main stack dry scrubbing system in 1997.

The highest fluoride and reactive aluminium concentrations measured at most sites during 2002 were determined during January. This was most likely due to the very low rainfalls during this month, which resulted in low dilution of material deposited on the deposition gauge collection surface. The rainfall fro January 2002 was 36mm compared to a 5-year average of 110mm.

Atmospheric Deposition

Fluoride in Ungrazed Grasses

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

Ungrazed Grass Monitoring Results

Annual average fluoride concentrations

The 2002 average ungrazed grass fluoride concentrations are shown in the following map.



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Monthly maximum concentration

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The following table shows the maximum monthly fluoride concentrations for sites off Tiwai Peninsula during 2002.

Sites off Tiwai Penninsula	Permit Guideline not to be exceeded more than once in any 12 month consecutive months.mgF/kg	Maximum Monthly Result During 2002 mgF/kg
Ungrazed Grass Site A	80	33
Ungrazed Grass Site B	80	31
Ungrazed Grass Site C	80	17
Ungrazed Grass Site E	80	9
Ungrazed Grass Site F	80	15
Ungrazed Grass Site G	80	9
Ungrazed Grass Site H	80	6
Ungrazed Grass Site I	80	11
Ungrazed Grass Site J	80	7
Ungrazed Grass Site K	80	8
Ungrazed Grass Site L and L2	80	54

The monthly fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2002.

Two-month average concentration

The following table shows the maximum two-month running average fluoride concentrations for sites off Tiwai Peninsula during 2002.

Sites off Tiwai Penninsula	Permit Guideline mgF/kg	Maximum Two Month Running Average During 2002 mgF/kg
Ungrazed Grass Site A	60	19
Ungrazed Grass Site B	60	25
Ungrazed Grass Site C	60	15
Ungrazed Grass Site E	60	7
Ungrazed Grass Site F	60	13
Ungrazed Grass Site G	60	9
Ungrazed Grass Site H	60	6
Ungrazed Grass Site I	60	10
Ungrazed Grass Site J	60	8
Ungrazed Grass Site K	60	5
Ungrazed Grass Site L and L2	60	33

The two-month running average fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2002.

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Running 12 month average concentration

The following table shows the maximum 12-month running average fluoride concentrations for sites off Tiwai Peninsula during 2002.

Sites off Tiwai Penninsula	Permit Guideline mgF/kg	Maximum Twelve Month Running Average During 2002 mgF/kg
Ungrazed Grass Site A	40	7
Ungrazed Grass Site B	40	10
Ungrazed Grass Site C	40	9
Ungrazed Grass Site E	40	6
Ungrazed Grass Site F	40	9
Ungrazed Grass Site G	40	6
Ungrazed Grass Site H	40	5
Ungrazed Grass Site I	40	6
Ungrazed Grass Site J	40	5
Ungrazed Grass Site K	40	5
Ungrazed Grass Site L and L2	40	12

The 12-month running average fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2002.

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Comments

The 2002 annual average fluoride concentrations in ungrazed grass sites off Tiwai Peninsula are similar to the annual average fluoride concentration levels in 2001.

Sites on Tiwai Peninsula and close to the smelter are also similar to the annual average fluoride concentrations levels in 2001.

The maximum monthly concentration recorded at sites A (33 mg F/kg) was observed during the month of May. This vegetation site may have been affected by smelter discharges to air as some of the dispersion conditions were in the direction of this site in the 7 days prior to sampling. Site 1 in the same direction but closer to site also showed a slight increase in fluoride concentration but not to the same magnitude as Site A. Port and or other activities at Bluff may have influenced Site A.

The maximum monthly concentration recorded at Site B (31 mg F/kg) was observed in July. This increased fluoride concentration may have been influenced by smelter emissions as dispersion conditions in the 7 days prior to sampling were to the west.

After approval from Environment Southland the location of site L was changed to L2 in September. L2 is approximately 250m southeast of the original site L and closer to the NZAS site. The change was requested, as there appeared to have been stock grazed on site L. Site L2 is outside the fenced area, and is unlikely to become grazed in the foreseeable future. Due to the close proximity of these two sites, and to ensure the impact of Smelter operations can continued to be assessed in this area, data from Site L and Site L2 is used concurrently. 1

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Fluoride in Pinus radiata

Introduction

This chapter covers the monitoring of fluoride in *Pinus radiata* at 7 monitoring sites located at Bluff, Awarua Plains, Waituna and Tiwai Peninsula.

Permit Guidelines

Pine needles between one and two years 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 2002 annual average fluoride concentrations of pine needle samples collected from the monitoring sites are shown in the following map.



Comments

Fluoride concentrations in *Pinus radiata* needles were within the permit guideline during 2002.

Fluoride concentrations of pine needles at all sites off Tiwai Peninsula were similar to the 2001 levels. Sites close to the smelter (P1, P2 and P6) have shown a decrease in fluoride concentration.

The pine tree at P2 site will change from the beginning of 2003 to a tree 50 metres north of the current tree. The reason for the change is that the current tree is encroaching over the road and has become a safety hazard. It is proposed that commencing from January 2003, data from the substitute tree is used in all reports and that the new site is designated "Pine Needle site P2B".

The Health of Farm Livestock

Grazing Monitor Project

Summary

The fluoride concentrations of grazed pasture on all grazing monitor farms were within permit standard during 2002.

Cattle urinary fluoride concentrations on GMF4 measured during 2002 were within the guidelines.

Cattle bone fluoride concentrations on GMF4 were generally in the range of results determined on this farm over the last several years.

Dental scores in cattle teeth formed on GMF4 were similar to those measured in 2001.

Introduction

Air Discharge and Coastal Permit Number 93566 requires NZAS to report on the health of farm livestock annually. The permit conditions were revised following NZAS' application to change or cancel some conditions, which was approved by the Southland Regional Council on 5 August 1998.

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.



The health of farm livestock is monitored by:

- measuring the fluoride concentration of cattle urine,
- measuring the fluoride concentration of cattle tailbone, and
- assessing the dental condition of cattle.

Urinary Fluoride

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

Bone Fluoride

The bone samples collected for measuring fluoride concentrations are from tailbone biopsies. The tailbone fluoride concentrations are converted to a metacarpal/metatarsal bone fluoride concentration using the method developed by J. Suttie.

Fluoride (F) in dry fat free metacarpal/metatarsal bone = F in ashed tailbone * 0.5.

Dental Condition

The tooth scoring system follows the method of J. Suttie. As most effects on teeth occur prior to eruption, when the teeth are forming, the tooth scores are given in relation to the year during which the tooth was formed. There is over 1 year between formation and eruption so the dental condition cannot be assessed until 1 to 2 years after any effects have occurred.

The inspection results from past years are combined to provide a table summarising the dental condition of the cattle permanent incisor teeth for the years when the teeth are forming.

Permit Standards

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

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

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

Permit Guidelines

The Air Discharge and Coastal Permit also contains 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 dairy and beef cattle should not exceed 10 mg/L corrected to S.G. 1.030,
- bone fluoride concentrations as measured in metacarpal/metatarsal bones are:
 - ◆ 1605 mg/kg for two year olds,
 - ◆ 2379 mg/kg for four year olds, and
 - 2794 mg/kg for six year olds.

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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 2002.

	Units	Standard	2002
Monthly sample maximum	mg/kg	80	47
Two monthly average maximum	mg/kg	60	28
Twelve monthly running average maximum	mg/kg	40	13
Annual average	mg/kg		10

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2000 and 2001.



Fluoride in grazed pasture, 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 2002 average grazed pasture fluoride concentration of 10 mg/kg was similar to the 2000 average. This result is affected by the high result of 47mg/kg in July. This was possible due to fertilizer being applied in mid June. July sampling was just outside the 28-day limit for reporting exemption. Contributing to this increased fluoride was the very low rainfall in July. The rainfall in July was 36mm compared with the 5-year average of 89mm.

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 2002.

	Units	Standard	2002
Monthly sample maximum	mg/kg	80	17
Two monthly average maximum	mg/kg	60	14
Twelve monthly running average maximum	mg/kg	40	8
Annual average	mg/kg		6

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2001 and 2002.



Fluoride in grazed pasture, 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 2002 average grazed pasture fluoride concentration of 6 mg/kg was similar to the average fluoride concentration measured during 2001. There was no sample data for March 2001 as fertilizer has been applied within 20 days of the sample being taken.

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 2002.

	Units	Standard	2002
Monthly sample maximum	mg/kg	80	8
Two monthly average maximum	mg/kg	60	6
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 2001 and 2002.



Fluoride in grazed pasture, 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 2002 annual average grazed pasture fluoride concentration of 5 mg/kg was similar to the concentration measured during previous years. There was no sample data for February 2002 as fertilizer had been applied within 20 days of sampling.

Introduction

The following information is contained in this section:

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

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2002.

	Units	Standard	2002
Monthly sample maximum	mg/kg	80	12
Two monthly average maximum	mg/kg	60	11
Twelve monthly running average maximum	mg/kg	40	7
Annual average	mg/kg		7

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2001 and 2002.



Grazing Monitor Project

Fluoride in grazed pasture, 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 2002.

	Units	Guideline	2002
Average fluoride concentration	mg/L	-	3.4
Maximum fluoride concentration	mg/L	10	9.1
Minimum fluoride concentration	mg/L	-	1.8
No. of samples	mg/L	-	9

Cattle urinary fluoride, continued

The following graph shows the results of urinary fluoride monitoring of cattle during 2001 and 2002. The horizontal bars show the average concentration of the samples and the vertical bars show the range of concentrations.



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



Cattle bone fluoride

The following table shows the results of bone fluoride monitoring during 2002.

Identification	Age	Units	Guideline	2002
76	2	mg/kg	1605	650
9/15	4	mg/kg	2379	925
79	2	mg/kg	1605	525
98/1	6	mg/kg	2,794	1500

The following graph shows the bone fluoride concentration of individual biopsies collected from two-year-old cattle since the project began.



Cattle bone fluoride, continued

The following graph shows the bone fluoride concentration of individual biopsies collected from four-year-old cattle since the project began.



The following graph shows the bone fluoride concentration of individual biopsies collected from six-year-old cattle since the project began.



Grazing Monitor Project

Cattle dental condition

The following table summarises combined results of the dental inspection of cattle.

Year of tooth formation	1997	1998	1999	2000	2001
Average tooth score	2	2	2	3	3
Maximum tooth score	3	2	3	3	3
Minimum tooth score	1	2	2	2	2
No. of cattle inspected	6	7	5	3	3

The following graph shows the average tooth score and range of tooth scores for the teeth of cattle formed since monitoring began.



Comments

The fluoride concentrations of cattle bone, grazed pasture and cattle urine on GMF4 were within the permit guidelines during 2002.

The 2002 annual average grazed pasture fluoride concentration of 7 mg/kg was similar to that determined during 2001. There is no data for January 2001 and December 2001 as fertilizer had been applied within 20 days of sampling.

The annual average urinary fluoride concentration measured during 2002 was 3.4 mg/L compared to 1.9 mg/L measured during 2001. The maximum individual urinary fluoride concentration measured during 2002 was 9.1 mg/L compared with a maximum of 4.7 mg/L measured during 2001. These figures show an increase from 2001 but are similar to 2000.

The average fluoride concentration of bones sampled from cattle during 2002 has decreased slightly this year compared to the last five years.

The dental scores in cattle inspected during 2002 were similar to those inspected in 2001.

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 2002.

	Units	Standard	2002
Monthly sample maximum	mg/kg	80	14
Two monthly average maximum	mg/kg	60	13
Twelve monthly running average maximum	mg/kg	40	10
Annual average	mg/kg		7

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2001 and 2002.



Fluoride in grazed pasture, 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 2002 average grazed pasture fluoride concentration of 7 mg/kg was similar to the average fluoride concentration measured during 2001. There is no data for February 2002 as fertilizer had been applied within 20 days of sampling.

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 2002.

	Units	Standard	2002
Monthly sample maximum	mg/kg	80	24
Two monthly average maximum	mg/kg	60	23
Twelve monthly running average maximum	mg/kg	40	11
Annual average	mg/kg		10

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2001 and 2002.



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Fluoride in grazed pasture, 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 2002 annual average grazed pasture fluoride concentration of 10 mg/kg was the similar to the average concentration measured in 2001.

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 2002.

	Units	Standard	2002
Monthly sample maximum	mg/kg	80	6
Two monthly average maximum	mg/kg	60	6
Twelve monthly running average maximum	mg/kg	40	6
Annual average	mg/kg		4

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2001 and 2002.



Fluoride in grazed pasture, 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 2002. The annual average grazed pasture fluoride concentration of 4 mg/kg was similar to the average concentration measured during 2001.

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 2001.

	Units	Standard	2002
Monthly sample maximum	mg/kg	80	11
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 2001 and 2002.



Fluoride in grazed pasture, continued

The following graph shows the annual average fluoride concentration in grazed pasture. Although GMF 16 was only included in the monitoring program in August 1994 an annual pasture graph has been produced including pre 1994 data from the neighbouring GMF 10 site. GMF10 was removed from the program in February 1998 as it is in the same ownership as GMF16 and pasture samples from the two farms during the years 1994 to 1998 indicated similar results.



Comments

The fluoride concentrations in grazed pasture were within the permit standards during 2002. The 2002 annual average grazed pasture fluoride concentration of 5 mg/kg was similar to the concentration measured in 2001. There was no sample data for March 2001 as fertilizer had been applied within 20 days of sampling.

Liquid Discharges and Their Effects

Introduction

Liquid discharges from the smelter are covered by six Coastal and Discharge Permits issued by the Southland Regional Council. These permits commenced in October 1996.

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	. 3	20
 Quarterly average total suspended solids 	g/m ²	
 Treated effluent Maximum daily discharge Total suspended solids Free cyanide 	m ³ /day g/m ³ g/m ³	140 100 20
Treated sewage	2	
Maximum daily flow	m ³ /day	295
Biochemical oxygen demand	g/m ³	18
Total suspended solids	g/m ³	8

The following permit limits apply to coastal water monitoring sites:

- the natural temperature shall not be changed by more than three degrees Celsius,
- the natural pH shall not be changed by more than 0.1 unit and at no time shall be less than 6.7 or greater than 8.5,
- there shall be no destruction of natural aquatic life by reason of a concentration of toxic substances nor shall the waters emit objectionable odours,
- the natural colour and clarity of the water shall not be changed to a conspicuous extent,
- the dissolved oxygen in solution in the waters shall not be reduced below 5 mg/litre,
- based on not fewer than five samples taken over not more than a 30 day period, the median value of the faecal coliform bacteria content of the waters shall not exceed 200/100 mL,
- there shall be no production of any conspicuous oil or grease films,
- the fluoride concentration of coastal water relating to drain discharges shall not exceed 5.0 g/m³, and
- the quarterly average fluoride concentration of coastal water relating to drain discharges shall not exceed 2.0 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 each discharge.

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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 bore north of the disposal area, upstream, and one bore south of the disposal area, downstream.

Monitoring is carried out at about six monthly intervals.

North Drain Discharges

Introduction

Discharges from the North Drain are covered by Coastal Permit 94501 which commenced on 8 October 1996.

Discharge monitoring results

The following table summarises the North Drain discharge monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
 Total suspended solids Annual average Maximum quarterly average No. of times quarterly average > 30 g/m³ 	g/m ³ g/m ³	- 30 0	7.3 10.0 0	12.2 16 0

Coastal water monitoring results

The following table summarises the North Drain weekly coastal water monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
Fluoride				
Annual average	g/m ³	-	1.4	1.3
Maximum quarterly average	g/m ³	2.0	1.4	1.3
• No. of times quarterly average $> 2.0 \text{ g/m}^3$		0	0	0
Maximum individual sample	g/m ³	5.0	1.8	2.0
• No. of times individual sample > 5.0 g/m^3	-	0	0	0
pH				
Maximum difference		0.1	0.1	0.1
• No. of times > 0.1		0	0	0
Visible oil				
• No. of times observed		0	0	0

The following table summarises the North Drain annual coastal water monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
Difference in temperature	°C	3.0	0.1	0.1
Minimum dissolved oxygen concentration	mg/litre	5.0	8.4	8.8

Comments

Discharges from the North Drain were within permit limits during 2002.

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South Drain Discharges

Introduction

Discharges from the South Drain are covered by Coastal Permit 94503 which commenced on 8 October 1996.

Discharge monitoring results

The following table summarises the South Drain discharge monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
Total suspended solids				
Annual average	g/m ³	-	2.0	1.7
Maximum quarterly average	g/m ³	30	2.5	2.4
• No. of times quarterly average > 30 g/m ³		0	0	0

Coastal water monitoring results

The following table summarises the South Drain weekly coastal water monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
Fluoride				
Annual average	g/m ³	-	1.3	1.3
Maximum quarterly average	g/m ³	2.0	1.3	1.3
• No. of times quarterly average > 2.0 g/m^3		0	0	0
Maximum individual sample	g/m ³	5.0	1.4	1.5
• No. of times individual sample $> 5.0 \text{ g/m}^3$	~	0	0	0
pH				i
Maximum difference		0.1	0.1	0.3
• No. of times > 0.1		0	0	1
Visible oil				
No. of times observed		0	0	0

The following table summarises the South Drain annual coastal water monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
Difference in temperature	°C	3.0	0.2	0.1
Minimum dissolved oxygen concentration	mg/litre	5.0	8.7	9.1

Comments

Discharges from the South Drain were within permit limits during 2002 as on the one occasion when the difference in pH exceeded 0.1 pH units, it was not considered that this difference was caused by any discharges from the smelter.

Liquid Discharges

West Drain Discharges

Introduction

Discharges from the West Drain are covered by Coastal Permit 94502 which commenced on 8 October 1996.

Discharge monitoring results

The following table summarises the West Drain discharge monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
Total suspended solids • Annual average	g/m^3	-	6.7	12
 Maximum quarterly average 	g/m ³	30	9.5	21.1
 No. of times quarterly average > 30 g/m³ 		0	0	0

Coastal water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001	2002
			Result	Result
Fluoride				
Annual average	g/m ³	-	1.3	1.3
Maximum quarterly average	g/m ³	2.0	1.3	1.3
• No. of times quarterly average $> 2.0 \text{ g/m}^3$		0	0	0
Maximum individual sample	g/m ³	5.0	1.4	1.4
• No. of times individual sample > 5.0 g/m^3		0	0	0
pН				
Maximum difference		0.1	0.1	0.1
• No. of times > 0.1		0	0	0
Visible oil				
• No. of times observed		0	0	0

The following table summarises the West Drain annual coastal water monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
Difference in temperature	°C	3.0	0.5	0.2
Minimum dissolved oxygen concentration	mg/litre	5.0	8.7	8.9

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West Drain Discharges, Continued

Comments

Discharges from the West Drain were not all within permit limits during 2002.

On two occasions during the year (May 23rd and September 10th) the natural colour and clarity of the receiving seawater was changed to a conspicuous extent by discharges from this drain. The cause both times was from rain, washing carbon material, which had been deposited on the ground during routine operations into the drain. Remedial actions to prevent further incidents of this type were implemented.

Treated Sewage Discharges

Introduction

Discharges of treated sewage onto land are covered by Discharge Permit Number 96122, which was granted on 16 October 1996.

Discharge monitoring results

The following graph shows the daily sewage discharge flow during 2001 and 2002. The permit limit for daily flow is 295 m^3 /day.



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



Liquid Discharges

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Treated Sewage Discharges, Continued

Discharge monitoring results, continued

The following graph shows the monthly biochemical oxygen demand (BOD_5) discharge from the sewage treatment plant during 2001 and 2002. The permit limit for BOD₅ is 18kg/day.



The following graph shows the annual average BOD₅ discharge from the sewage treatment plant.



Liquid Discharges

Treated Sewage Discharges, Continued

Discharge monitoring results, continued.

The following graph shows the monthly suspended solids discharge from the sewage treatment plant during 2001 and 2002. 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.



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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 map on page LD.2.

Demonster	Units	2001	2002	Previous Range
Parameter	Units	Average	Average	(post commission)
North Bore (Upstream)				
Faecal coliforms	MPN/100 ml	<2	< 2	<2
Total phosphorus	g/m ³	0.08	0.07	0.07 - 0.15
Total ammoniacal-N	g/m ³	0.03	0.01	0.01 - 0.03
Nitrate-N	g/m ³	0.004	0.002	< 0.01 - 0.06
Total Nitrogen	g/m ³	0.10	0.10	0.08 - 0.2
pH		7.8	7.7)	7.8 - 8.1
Conductivity	µS/cm	327	321	309 - 332
Chlorinated Aliphatic HC	g/m ³	N.D.	B.L.	B.L.
South Bore (Downstream)				
Faecal coliforms	MPN/100 ml	<2	2	< 2 - 23
Total phosphorus	g/m ³	0.01	0.01	0.01 - 0.04
Total ammoniacal-N	g/m ³	<0.01	<0.01	0.01 - 0.02
Nitrate-N	g/m ³	0.091	0.068	0.02 - 0.35
Total Nitrogen	g/m ³	0.26	0.37	0.23 - 0.62
pH		7.7	7.2	7.2 - 7.9
Conductivity	μS/cm	401	284	252 - 415
Chlorinated Aliphatic HC	g/m ³	N.D.	B.L.	B.L.

HC = HydrocarbonsN.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 2002 were within permit limits.

Groundwater monitoring results are similar or lower to those reported in 2001.

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Treated Effluent Discharges

Introduction

Discharges of treated effluent into Foveaux Strait are covered by Coastal Permit Number 94488, which commenced on 11 October 1996.

Discharge monitoring results

The following table summarises the results of treated effluent discharge monitoring during 2002 and shows a comparison with the 2001 results.

Parameter	Units	Limits	2001 Result	2002 Result
Maximum daily discharge	m ³ /day	140	80	80
Suspended Solids Maximum Concentration			15	54
Average Concentration No.> 100 g/m^3	g/m ³	100 0	4.3 0 0	9.2 0
Free Cyanide Maximum Concentration Average Concentration	g/m ³	20	13.7 3.3	16.3 3.5
No.> 20 g/m ³		0	0	0

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



Liquid Discharges

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Treated Effluent Discharges, Continued

Discharge monitoring results, continued

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



Coastal water monitoring results

The following table summarises the treated effluent annual coastal water monitoring results during 2002 and shows a comparison with 2001 results.

Parameter	Units	Limit	2001 Result	2002 Result
Change to temperature	°C	3.0	0.3	0
Change to pH		0.1	0.0	0.0
Dissolved oxygen	mg/L	>= 5.0	8.8	8.6
No of times visible oil observed		0	0	0

Comments

All discharges of treated effluent were within permit limits during 2002.

Landfill Operations

Introduction

Operation of the landfill on the smelter's Tiwai Point property is covered by Discharge Permit No. 94460 issued by the Southland Regional Council on 30 October 1995.

This report covers:

- proposed operation at the landfill for the next twelve months,
- the amount and type of materials deposited at the landfill, and
- groundwater monitoring.

Proposed Operation For 2003

Introduction

The proposed operation of the landfill for 2003 is outlined in the NZAS Landfill Management Plan. Additional details on the proposed operations during 2003 are included in the following sections.

Landfill areas being developed or extended

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



Proposed Operation For 2003, Continued

Landfill areas being developed or extended, continued

A new general waste tip face opened for use in 2003 (stage 9). Its use will continue through 2003 in a westerly direction to the boundary of the landfill area.

Stage 8 general waste was closed and covered in pea gravel late in 2002.

Stage 10 carbon dust tipping area was opened in 2002 and will continue operation through 2003. Access to stage 10 is through part of the old tipping area with the dormant part now covered in pea gravel.

All tipping faces are marked with sleepers and signage and limited to 15 metres wide.

Significant native plants in the path of the new faces (stages 9 and 10) will be relocated to closed cells in 2003.

Special Work in 2003

Dumping of filter bags from Fumes Scrubbers.

13000, 8m long by 200mm diameter felt bags will be disposed of in the landfill.

Recovery of Aluminium from Dross (MRP)

Trials are planned to recover aluminium from the dross dumped in previous years.

Reopening of MRP (dross) area.

Installation of dust collection in the plants dross recovery area means a resumption of dumping is required in the MRP area. It is estimated to be 3 tonnes per month.

Dumping of Drain Sediment.

Approximately 800 tonnes of sediment from Reduction Line drains will be disposed of in an area adjacent to the general tipping face.

Amount and Type of Materials Deposited

Introduction

Each year the smelter surveys the amount and type of material deposited at the Tiwai Point Landfill. The survey is usually conducted over a period of about four weeks during early summer.

Survey procedure

The survey period for took place over a period of 30 days in January and February 2003.

- Each truck load of waste was weighed before and after deposition at the landfill to obtain an accurate weight
- The contents and source of each truckload is recorded
- The amount of waste measured during the survey is used to estimate the annual deposition.
- Annual estimates are corrected to account for any special events that may occur during the annual survey.

Survey comments

Estimated total waste to the landfill has decreased from 5198 tonnes (2001) to 4565 tonnes (2002). It is estimated that the margin of error for this survey is \pm 300 tonnes.

No asbestos material was recorded during the survey. A disposal point at the landfill is available for this material but none is regularly generated and no plans are known that will result in any significant dumping.

Better classification in this survey shows an increase in plastic, paper and cardboard. This is off set by a 570 tonne decrease in non-classifiable waste.

The survey also indicates a 100 tonne decrease in furnace slag. This decrease is due to process improvements in the Carbon Rodding area and furnace practices.

Major changes during 2002 included:

- A decrease of 90 tonnes per year going to clean fill. Clean material (concrete and rubble) is now being sold for fill where possible, and
- a decrease of 450 tonnes going to the general tip face.

Amount and Type of Materials Deposited, Continued

Estimate for 2002.

The following table shows the estimated amount of waste deposited at the Tiwai Point Landfill during 2001 and 2002.

Type of Waste	2001 Yearly Estimate	2002 Yearly Estimate
Type of Waste	(tonnes)	(tonnes)
Bath (Reject)	175	63
Bricks	334	182
Carbon Material	3199	3359
Concrete and Rubble	101	0
D/C filter Bags	6	2
Furnace Slag	247	144
Furnace Elements	5	0
Organic	3	3
Metal Dust	42	0
Alumina	0	16
Non-classified Waste	772	200
Paper + Cardboard	28	159
Plastic	22	142
Resistor Coke	110	110
Timber	94	101
Rubber	20	14
Textiles	14	5
Asbestos	<1	0
Floor Sweepings	26	0
Sand	0	19
Steel	0	5
Drain Sediment	0	41
Totals	5198	4565

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Landfill Groundwater Monitoring

Site locations

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



Bore A20 monitoring results

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The table below shows a summary of results from samples collected from bore A20 during 2001 and 2002. Bore A20 is located north of the landfill (upstream).

Analyte	Units	2001	2002	Range (since	
		Average	Average	Commissioning)	
Temperature	°C	11.1	10.3	7.5 - 13.4	
pH		5.7	6	5.4 - 7.2	
Conductivity	μS/cm	805	718	644 - 845	
Alkalinity	g/m ³	23	33	8 - 146	
Carbonaceous BOD5	g/m ³	2.2	0.5	1 - 6	
Total Nitrogen	g/m ³	0.58	0.35	0.1 - 1.3	
Total Ammoniacal Nitrogen	g/m ³	0.06	0.06	0.04 - 0.16	
Fluoride	g/m ³	0.21	0.08	0.03 - 0.25	
Sulphate	g/m ³	33	34	27 - 47	
Total Iron	g/m ³	6.1	14.6	0.7 - 13.5	
Total Petroleum Hydrocarbons	g/m ³	2.5	0.5	0.3 - 11.6	
Total Kjeldahl Nitrogen	g/m ³	0.5	N.D.	0.4 - 0.5	
Nitrate Nitrogen	g/m ³	0.41	N.D.	0.003 - 14	
Nitrite Nitrogen	g/m ³	0.001	N.D.	0.001 - 0.014	
Weak Acid Dissociable Cyanide	g/m³	0.001	N.D.	0.001 - 0.1	
Boron	g/m ³	0.04	N.D.	0.038 - 0.067	
Manganese	g/m ³	0.29	N.D.	0.115 - 0.394	
Nickel	g/m ³	0.007	N.D.	0.002 - 0.01	
Potassium	g/m ³	3.6	N.D.	3.3 - 4.1	
Vanadium	g/m ³	0.001	N.D.	0.001 - 0.003	

N.D: Not analysed – only required biennially.

Bore A21 monitoring results

The table below shows a summary of results from samples collected from bore A21 during 2001 and 2002. Bore A21 is located north of the landfill (upstream).

Analyte	Units	2001	2002	Range (since	
-		Average	Average	Commissioning)	
Temperature	°C	11.35	10.5	6.5 - 13.7	
pН		5.4	5.5	5.1 - 6.3	
Conductivity	μS/cm	983	957	683 - 1723	
Alkalinity	g/m3	10	19	9 - 160	
Carbonaceous BOD5	g/m3	1.7	1.3	1 - 16	
Total Nitrogen	g/m3	0.8	1.2	0.7 - 8	
Total Ammoniacal Nitrogen	g/m3	0.20	0.30	0.1 - 4.6	
Fluoride	g/m3	0.37	0.60	0.19 - 0.83	
Sulphate	g/m3	58	69	29 - 101	
Total Iron	g/m3	4.3	15.8	2.2 - 94.6	
Naphthalene	mg/m3	0.005	0.028	0.003 - 0.1	
Anthracene	mg/m3	0.004	0.009	0.002 - 0.03	
Phenanthrene	mg/m3	0.009	0.009	0.002 - 0.02	
Fluoranthene	mg/m3	0.002	0.009	0.002 - 0.01	
Total Petroleum Hydrocarbons	g/m3	2.50	0.50	0.3 - 7.3	
Total Kjeldahl Nitrogen	g/m3	0.9	N.D.	0.9 - 6.5	
Nitrate Nitrogen	g/m3	0.02	N.D.	0.01 - 29	
Nitrite Nitrogen	g/m3	0.001	N.D.	0.001 - 0.028	
Weak Acid Dissociable Cyanide	g/m3	0.001	N.D.	0.001 - 0.1	
Boron	g/m3	0.109	N.D.	0.077 - 0.154	
Manganese	g/m3	0.1	N.D.	0.1 - 0.473	
Nickel	g/m3	0.003	N.D.	0.003 - 0.007	
Potassium	g/m3	5.4	N.D.	5.4 - 11.3	
Vanadium	g/m3	0.005	N.D.	0.001 - 0.043	

N.D: Not analysed – only required biennially.

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Bore A22 monitoring results

The table below shows the averages of results from samples collected from bore A22 during 2001 and 2002. Bore A22 is located west of the landfill.

Analyte	Units	2001	2002	Range (since	
-		Average	Average	Commissioning)	
Temperature	⁰ C	10.5	10.2	8.6 - 12.1	
pН		4.3	5.7)	4.2 - 7.3	
Conductivity	μS/cm	636	(408)	354 - 1204	
Alkalinity	g/m3	0.5	10.50	0.5 - 294	
Carbonaceous BOD5	g/m3	1.9	1.5	1 - 12	
Total Nitrogen	g/m3	2.1	1.00	0.4 - 2.8	
Total Ammoniacal Nitrogen	g/m3	0.1	0.16	0.05 - 0.47	
Fluoride	g/m3	2	1.80	0.4 - 2.4	
Sulphate	g/m3	30	13	10 - 44	
Total Iron	g/m3	0.8	2.70	0.6 - 3.5	
Total Petroleum Hydrocarbons	g/m3	2.5	0.50	0.3 - 10.7	
Total Kjeldahl Nitrogen	g/m3	1.9	N.D.	0.9 - 1.9	
Nitrate Nitrogen	g/m3	0.01	N.D.	0.01 - 0.2	
Nitrite Nitrogen	g/m3	0.004	N.D.	0 - 0.042	
Weak Acid Dissociable Cyanide	g/m3	0.002	N.D.	0.001 - 0.1	
Boron	g/m3	0.059	N.D.	0.006 - 0.066	
Manganese	g/m3	0.025	N.D.	0.005 - 0.394	
Nickel	g/m3	0.01	N.D.	0.001 - 0.01	
Potassium	g/m3	2.6	N.D.	2.1 - 4.1	
Vanadium	g/m3	0.008	N.D.	0.002 - 0.022	

N.D: Not analysed – only required biennially.

Bore A23 monitoring results

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The table below shows a summary of results from samples collected from bore A23 during 2001 and 2002. Bore A23 is located west of the landfill.

Analyte	Units	2001	2002	Range (since	
		Average	Average	Commissioning)	
Temperature	°C	10.4	10.5	9 - 12.5	
pН		6 5.9		5.4 - 6.1	
Conductivity	μS/cm	531	425	378 - 745	
Alkalinity g/m3 36 34		34	31 - 60		
Carbonaceous BOD5	g/m3	0.8	1	0.5 - 5	
Total Nitrogen	g/m3	2.1	2.0	0.9 - 2.7	
Total Ammoniacal Nitrogen	g/m3	1.0	1.0	0.05 - 1.4	
Fluoride	g/m3	0.2	0.17	0.03 - 0.36	
Sulphate	g/m3	2.5	0.3	0.3 - 30	
Total Iron	g/m3	6.5	5.6	4.4 - 13	
Total Petroleum Hydrocarbons	g/m3	2.5	0.5	0.3 - 7.2	
Total Kjeldahl Nitrogen	g/m3	2.3	N.D.	1.8 - 2.3	
Nitrate Nitrogen	g/m3	0.01	N.D.	0.01 - 0.05	
Nitrite Nitrogen	g/m3	0.003	N.D.	0.001 - 0.019	
Weak Acid Dissociable Cyanide	g/m3	0.002	N.D.	0 - 0.1	
Boron	g/m3	0.045	N.D.	0.038 - 0.05	
Manganese	g/m3	0.055	N.D.	0.055 - 0.118	
Nickel	g/m3	0.002	N.D.	0 - 0.002	
Potassium	g/m3	4.4	N.D.	4 - 5	
Vanadium	g/m3	0.015	N.D.	0.013 - 0.021	

N.D: Not analysed – only required biennially.

Bore A24 monitoring results

The table below shows a summary of results from samples collected from bore A24 during 2001 and 2002. Bore A24 is located south east of the landfill.

Analyte	Units	2001	2002	Range (since	
J		Average	Average	Commissioning)	
Temperature	°C	10.7	10.6	9.4 - 12.8	
pH		7.6	7.5	6.9 - 7.6	
Conductivity	μS/cm	2930	1870	1400 - 4410	
Alkalinity	g/m3	890	574	414 - 1182	
Carbonaceous BOD5	g/m3	9	8	2 - 17	
Total Nitrogen	g/m3	98.5	66	16.8 - 152	
Total Ammoniacal Nitrogen	g/m3	80	56	28.2 - 146	
Fluoride	g/m3	9.4	29	0.5 - 21	
Sulphate	g/m3	21	87	5 - 312	
Total Iron	g/m3	25.8	12	8.2 - 29.5	
Naphthalene	mg/m3	25.1	3.6	0.1 - 82	
Anthracene	mg/m3	0.199	0.085	0.005 - 0.32	
Phenanthrene	mg/m3	0.105	0.075	0.003 - 0.18	
Fluoranthene	mg/m3	0.036	0.015	0.003 - 0.06	
Total Petroleum Hydrocarbons	g/m3	2.5	0.5	0.3 - 18.6	
Total Kjeldahl Nitrogen	g/m3	83.8	N.D.	67 - 83.8	
Nitrate Nitrogen	g/m3	1.23	N.D.	0.05 - 1.23	
Nitrite Nitrogen	g/m3	0.632	N.D.	0.01 - 0.632	
Weak Acid Dissociable Cyanide	g/m3	0.008	N.D.	0.005 - 0.1	
Boron	g/m3	5	N.D.	4 - 5	
Manganese	g/m3	0.13	N.D.	0.11 - 0.13	
Nickel	g/m3	0.01	N.D.	0 - 0.01	
Potassium	g/m3	31.7	N.D.	11.1 - 31.7	
Vanadium	g/m3	0.4	N.D.	0.3 - 0.4	

N.D: Not analysed – only required biennially.

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Bore A6 monitoring results

The table below shows a summary of results from samples collected from bore A6 during 2001 and 2002. Bore A6 is located south east of the landfill.

Analyte	Units	2001 Average	2002 Average	Range (since Commissioning)	
Temperature	°C	12.05	11.1	10.3 - 13.5	
pH		6.95	7.1	6.4 - 7.2	
Conductivity	μS/cm	2865	2838	158 - 5689	
Alkalinity	g/m ³	484	814	478 - 943	
Carbonaceous BOD5	g/m ³	2.5	4	1 - 6	
Total Nitrogen	g/m ³	22.5	30	9.7 - 44	
Total Ammoniacal Nitrogen	g/m ³	3.205	18	1.3 - 31.5	
Fluoride	g/m ³	72	17	1.5 - 104	
Sulphate	g/m ³	792	886	674 - 2050	
Total Iron	g/m ³	11	13.95	9.9 - 22.6	
Naphthalene	mg/m ³	0.010	0.050	0.003 - 0.05	nypase
Anthracene	mg/m ³	0.372	0.900	0.05 - 1.34/	
Phenanthrene	mg/m ³	0.011	0.055	0.005 - 0.08	
Fluoranthene	mg/m ³	0.0050	0.015	0.003 - 0.09	
Total Petroleum Hydrocarbons	g/m ³	2.5	0.5	0.3 - 9.2	
Total Kjeldahl Nitrogen	g/m ³	14.2	N.D.	14.2 - 23.4	
Nitrate Nitrogen	g/m ³	8.58	N.D.	0 - 14	
Nitrite Nitrogen	g/m ³	0.034	N.D.	0.004 - 0.17	
Weak Acid Dissociable Cyanide	g/m ³	0.013	N.D.	0.013 - 0.1	
Boron	g/m ³	0.9	N.D.	0.9 - 2.5	
Manganese	g/m ³	1.5	N.D.	0.2 - 1.9	
Nickel	g/m ³	0.022	N.D.	0.005 - 0.022	
Potassium	g/m ³	17.6	N.D.	17.6 - 37]
Vanadium	g/m ³	0.07	N.D.	0.05 - 0.22	

N.D: Not analysed – only required biennially.

Comments

This year the analysis method for the determination of Total Nitrogen was changed to a calculation method as approved by Environment Southland (ref N015-001, N015-006).

Apart from Bore A24 and A6 the groundwater monitoring data from the bores near the landfill do not indicate any significant trends in the general groundwater quality during 2002.

Bore A24 is showing an increasing trend in the level of fluoride over the last two years and fluctuating fluoride concentrations since late 1999 when an new MRP fines storage cell was commissioned. Bore A24 is located approximately 200 metres south west of the MRP fines storage area. MRP fines are no longer being deposited at the landfill. Deposition of MRP fines stopped during quarter three 2001. In 2003 the MRP area at the landfill will be reopened to allow the disposal of dust from the dust collector in the dross recovery area. A trial is planned during 2003 to recover aluminium from the landfilled dross in this area.

Bore A6 showed an unusually high level of Anthracene (1.34mg/m^3) during the June survey. The previous range for this analyte was $0.05 - 0.72 \text{mg/m}^3$. This apparent increase was attributed to heavy rainfall in early June, as the depth of water in all the bores during this survey was greater than normal. Bore A6 is east of the old carbon fines area and most of the ground water flow, is to the ocean beach, to the east of the landfill site.

Groundwater

Spent Cathode Pad Leachate

A 'snapshot' study was carried out during 2002 and the report forwarded to Environment Southland. As a result of that study it was recommended that a further 'snapshot' study be taken in three years.

The report indicates further reduction in the groundwater contamination of both the pea gravel and fine sand layers south of the storage pad.

NZAS has decided to maintain a limited monitoring program of the spent Cathode Pad leachate to ensure any future leakage is determined early and appropriate action may be taken to avoid damage to the environment.

The monitoring included measuring the conductivity in the groundwater of three monitoring wells at six-monthly intervals, and a further six wells at 123 monthly intervals. The monitoring in 2002 indicated no leakage.

Diesel Bioremediation

A 'snapshot' survey was undertaken during 2002 and the report forwarded to Environment Southland. The results showed that there has been no movement of diesel off-site. A comprehensive survey is due to be carried out in 2006.

Spent Cell Lining Storage Shed

Monitoring of the membranes under the Spent Cell Lining storage shed continued during 2002. A pumping program to remove the water from the membrane, detected in quarter four 2001, was started in August 2002. The elevated concentrations of cyanide and fluoride in the liquid have started to show a decrease but are still not back to pre 2001 concentrations. Monitoring of the groundwater around the shed show that the concentrations of cyanide and fluoride in the groundwater have not changed significantly or have been affected by the increased volume of liquid detected in the shed membranes.

Groundwater