

4. Monitoring Plan

4.1 Foreword

This Monitoring Plan describes the proposed long-term environmental monitoring program for the proposed Pulp Mill at Bell Bay, in northern Tasmania, as required by the *Final Scope Guidelines for the Integrated Impact Statement (IIS)* (RPDC IIS Final Scope Guidelines).

Environmental monitoring provides the information required to ascertain compliance with performance standards, quality assurance and project objectives. This ensures that environmental protection is optimised at all stages of the development through best practice environmental management (**BPEM**), and the use of accepted modern technology (**AMT**). It will also allow for the demonstration of compliance with regulatory requirements, in particular the Tasmanian Government's *Recommended environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania 2004* Volume 2 (RPDC Emission Limit Guidelines).

This monitoring program is designed to meet the following objectives as set out in schedule 10.2 of the RPDC IIS Final Scope Guidelines and D4.4 Emission Guidelines:

- ▶ *Pre-operational monitoring shall occur 2.5 years before commissioning of the proposed mill and measure same parameters as post operational monitoring;*
- ▶ *Monitoring compliance with emission standards and other performance requirements;*
- ▶ *Assessing the effectiveness of the performance requirements and emission limits and environmental safeguards in achieving environmental quality objectives;*
- ▶ *Assessing the extent to which the predictions described in the IIS have eventuated;*
- ▶ *Fulfilling the requirements of the conditions of approval for the project including, as a minimum, the RPDC Emission Limit Guidelines; and*
- ▶ *Assessing the progress to the meeting of commitments as outlined in Chapter 12 of the IIS Final Scope Guidelines, and specifying procedures for ensuring unmet commitments are achieved.*

The emission limits defined in this monitoring program have been set according to the RPDC Emission Limit Guidelines or other relevant State or Commonwealth legislation or policy. Where no limit has yet been set, DTAE are required to set these limits in consultation with Gunns Limited (Gunns). The lack of a current emission limit is represented in subsequent tables with a dash (-).

4.2 Background

Gunns proposes to establish a bleached Kraft pulp mill, with ancillary and off-site infrastructure, (herein referred to as the 'project'). The pulp mill is proposed to be established at the Bell Bay Industrial Estate, south of George Town in northern Tasmania.

Pulp is a processed fibre derived from wood that can be used for making paper and other products. Wood is provided in raw form as woodchip. The wood source for this project will be primarily plantation grown eucalypts, with additional native forest eucalypts, and a small proportion of plantation pine

species. In order to produce pulp, woodchips undergo a series of processes including screening, cooking, bleaching and drying to separate the wood fibre from the water and natural glues (lignin). For the purposes of this project, a pulp mill is a manufacturing facility where these processes occur. The pulp mill will be designed to best environmental and technological practices.

Ancillary infrastructure is required to supply elements and remove elements, such as water and waste, used or produced as part of the operation of the pulp mill, and to allow storage and transportation of pulp bales.

Overall the project consists of eight major infrastructure components as grouped below:

- ▶ A bleached Kraft pulp mill at Bell Bay;
- ▶ A wharf facility at Bell Bay;
- ▶ A landfill facility adjacent to the pulp mill;
- ▶ A quarry adjacent to the landfill;
- ▶ A water reservoir adjacent to the pulp mill;
- ▶ A water supply pipeline from Trevallyn Dam, near Launceston, to the pulp mill;
- ▶ An effluent pipeline from the pulp mill to Five Mile Bluff, including an ocean outfall to Bass Strait; and
- ▶ A workers accommodation facility at George Town.

The proposed pulp mill will use the Elemental Chlorine Free (ECF) bleaching process to produce approximately 820,000 air dry tonnes (ADt) in the initial 'ramp-up' stages of production, and will produce approximately 1,100,000 ADt at optimum capacity. The proposed pulp mill will be Kraft (strong) grade for domestic and international markets.

The pulp mill will contribute to the sustainability of Tasmania's forestry industry and the economy of Tasmania (and therefore Australia) by establishing a value adding process, which would otherwise be conducted overseas.

4.3 Point Source Monitoring

4.3.1 Atmospheric Emissions

Introduction

The Kraft pulp mill will be designed to treat gaseous wastes before release to the atmosphere. Based on the design of the proposed mill, gaseous wastes will be predominately released from a 130 metre tall recovery Boiler Stack (Jaako Pöyry Management Consulting 2004). After passing through electrostatic precipitators, gases would be released through this common stack, in separate flues, from three main locations within the pulp mill - the Recovery Boiler, the Lime Kilns and the Power Boiler.

Other emissions may also result from the:

- ▶ Waste water treatment plant;
- ▶ Chemical plant; and

- ▶ Bleach plant for the production of ClO₂

Monitoring Program Schedule

Point source monitoring of emissions is expected to occur from:

- ▶ Each of the flues within the common stack;
- ▶ The concentrated non-condensable gases (CNCG) incinerator; and
- ▶ The concentrated non-condensable gases (CNCG) emergency incinerator (when in use).

Mill wide process limits and in-plant air emission levels will also be measured in this monitoring program, as defined by the RPDC Emission Limit Guidelines. The schedule for monitoring atmospheric emissions at the pulp mill site is detailed in Table 5. This table outlines the parameters to be monitored, the emission limits, and the testing frequency for each parameter. The air emission discharge limits for the pulp mill are defined in the RPDC Emission Limit Guidelines and will be further developed in accordance with DPIWE requirements.

Monitoring Methodology

The monitoring program for atmospheric emissions from the pulp mill will be designed in accordance with the RPDC Emission Limit Guidelines and the Tasmanian *Environment Protection Policy (Air Quality) 2004* (which superseded the *Draft Environment Protection Policy (Air Quality) 2001* and which is referred to in the RPDC Emission Limited Guidelines).

Continuous monitoring equipment will be installed on each of the flues in the common stack, as well as on the concentrated non-condensable gases (CNCG) incinerator to record the following parameters:

- ▶ TRS;
- ▶ Nitrogen dioxide; and
- ▶ Sulphur dioxide
- ▶ Carbon Monoxide
- ▶ Hydrogen Chloride
- ▶ Inorganic Chlorinated Compounds.

State of the art computer controlled process systems including combustion control shall ensure optimum operations with alarming should set points be exceeded.

Note that particulates will be monitored continuously on the power and recovery boiler stacks as well as the lime kiln stack.

Calibration protocols for these instruments shall be defined by the instrument supplier and compliance externally audited as part of the ISO14001 certification process.

In addition independent NATA accredited emission testing consultants shall check the calibration as outlined in table 4.

The following advice was provided by Environmental Consultants Pty Ltd: -

The likely methodology to be employed for the insitu stack testing is consistent with USEPA CFR 40 Part

60 Methods and where applicable Australian Standards. The consultants shall be NATA accredited for the following tests: -

Table 4: Test required for consultants to be NATA accredited

Parameter	Method
Sampling plane	AS4323.1
Velocity, Temperature, Flow rate	USEPA Method 2
Gas Molecular Weight, Oxygen, Carbon Dioxide.	USEPA Method 3b
Moisture	USEPA Method 4
Total Particulates	USEPA Method 5/17 (AS4323.2)
PM10	USEPA Method 201a
Oxides of nitrogen	USEPA Method 7E
Sulphur Dioxide	USEPA Method 6c
Sulphur Trioxide/Sulphuric Acid Mist	USEPA Method 8
PAH*	USEPA SW846 Method 00100
Dioxins and Furans	USEPA Method 23
Total Reduced Sulphur	USEPA Method 15A
Hydrogen Chloride and Total Inorganic Chlorinated Cpds incl Chlorine	USEPA Method 26a
Volatile Organic Cpds*	USEPA Method 18
Metals*	USEPA Method 29
Chromium 6*	USEPA SW846 0061

* These parameters associated with National Pollutant Inventory annual assessment, all others are RPDC requirements.

Description of the principal sampling methods follows: -

Total Solid Particulates: AS4323.2 / USEPA Method 5 or Method 17

Particulate matter is withdrawn isokinetically from the source and collected on a glass fibre filter maintained at a temperature in the range of 120±14 °C or such other temperature as specified by an applicable subpart of the standards or approved by the administrator, U.S. EPA, for a particular operation for Method 5. In Method 17 the particulate matter is collected instack at stack conditions. The particulate mass, which includes any material that condenses at or above the filtration temperature, is determined gravimetrically after removal of uncombined water.

PM10 / PM2.5:

A gas sample is extracted at a constant flow rate through an in-stack sizing device, which separates PM greater than PM10 via inertial separation due to the particles diameter and momentum character.

Variations from isokinetic sampling conditions are maintained within well-defined limits. The particulate mass is determined gravimetrically after removal of un-combined water.

Oxygen & Carbon Dioxide

A sample is continuously extracted from the effluent stream; a portion of the sample stream is conveyed to an instrumental analyser(s) for the determination of O₂ and CO₂ concentrations. Performance specifications and test procedures are provided to ensure reliable data. The instrumental technique for carbon dioxide and oxygen is nondispersive infrared and paramagnetic sensor, respectively.

Carbon Monoxide

An integrated or continuous gas sample is extracted from a sampling point and analysed for carbon monoxide content using a Luft-type non-dispersive infrared (NDIR) or equivalent instrument.

Nitrogen Oxides as NO₂

A gas sample is continuously extracted from a stack and a portion of the sample is conveyed to an instrumental chemiluminescent analyser for determination of NO_x concentration. The subsequent results are then reported as Nitrogen Oxides as NO₂.

Sulphur Dioxide

A gas sample is continuously extracted from a stack and a portion of the sample is conveyed to an instrumental analyser employing an ultraviolet, non-dispersive infrared or fluorescence detection principle for determination of SO₂ concentration.

Acid Gases (HCl). A gas sample is extracted isokinetically from the stack in accordance with USEPA Method 26a. The hydrogen halides / acid mist fraction of the sample is separated in the front half of the impinger train and halogens are separated in the back half of the train. Both fractions are measured separately as required and analysed by Ion Chromatography.

PAHs

A sample of stack gas is extracted isokinetically into a USEPA method 5 configuration sampling train that has been pre-prepared to remove any organic compounds from the internal surfaces. All sampling components are glass/quartz. The modification to the sampling train includes the insertion of a glass water cooled condenser and XAD-2 resin trap. SVOC (including PAHs) are trapped on the filter and in the XAD-2 resin. The sample train is recovered post-sampling and the recovered sample analysed by GC/MS.

Dioxins and Furan

A sample of stack gas is extracted isokinetically into a USEPA method 5 configuration sampling train that has been pre-prepared to remove any organic compounds from the internal surfaces. All sampling components are glass/quartz. The modification to the sampling train includes the insertion of a glass water cooled condenser and XAD-2 resin trap. Dioxins and Furans are trapped on the filter and in the XAD-2 resin.

The sample train is recovered post-sampling and the recovered sample analysed by GC/MS.

Sulphur Dioxide & Sulphur Trioxide + Sulphuric Acid Mist

A gas sample is extracted isokinetically from the stack in accordance with USEPA Method 8. The sulphuric acid mist (including sulphur trioxide) and the sulphur dioxide are separated, and both fractions are measured separately by the barium-thorin titration method.

Hydrogen Chloride and Inorganic Chlorinated Compounds

A gas sample is extracted isokinetically from the stack. Hydrogen Halides and Halogens are separated in the sampling train. Total Inorganic Chlorides and Hydrogen Halides are expressed combined.

Maintenance of the instruments shall be an integral part of the eminence program.

Table 5: Emission Limits and Sampling Schedule for Point Source Air Emissions

Emission Source	Pollutant	Units	Testing Frequency	Annual Average Limit	Monthly Average Limit	Comments
Recovery boiler	PM	mg/NDm ³	Monthly initially then less frequent depending on results	-	50 @ 3% O ₂	Manual testing
	TRS	mg H ₂ S/NDm ³	Continuous	-	7 @ 3% O ₂ for >99% of the time Included in mill wide sulphur from all sources excluding power boiler	
	NO _x	mg NO ₂ /NDm ³	Continuous	-	Included in mill wide NO _x from all sources excluding power boiler	
	SO ₂	mg S/NDm ³	Continuous	-	Included in mill wide sulphur from all sources excluding power boiler	
	PCDD/PCDF	pg I-TEQ/NDm ³	Quarterly- 1 st year operation Twice yearly thereafter	-	100 @ 3% O ₂	Average over sampling period 4-8 hours
Lime Kiln	PM	mg/NDm ³	Monthly initially then less frequent depending on results	-	40 @ 3% O ₂	Manual testing
	TRS	mg H ₂ S/NDm ³	Continuous	-	16 @ 3% O ₂ for >95% of the time Included in mill wide sulphur from all sources excluding power boiler	
	NO _x	mg NO ₂ /NDm ³	Continuous	-	Included in mill wide NO _x from all sources excluding power boiler	

Emission Source	Pollutant	Units	Testing Frequency	Annual Average Limit	Monthly Average Limit	Comments
	SO ₂	mg S/NDm ³	Continuous	-		Included in mill wide sulphur from all sources excluding power boiler
	PCDD/PCDF	pg I-TEQ/NDm ³	Quarterly- 1 st year operation Twice yearly thereafter	-	100 @ 3% O ₂	Average over sampling period 4-8 hours
CNCG incinerator	TRS	mg H ₂ S/NDm ³	Continuous	-	7 @ 3% O ₂ for >99% of the time Included in mill wide sulphur from all sources excluding power boiler	
	NO _x	mg NO ₂ /NDm ³	Continuous	-	Included in mill wide NO _x from all sources excluding power boiler	
	SO ₂	mg S/NDm ³	Continuous	-	Included in mill wide sulphur from all sources excluding power boiler	
	SO ₂ +SO ₃	mg S/NDm ³	Twice Yearly	-	Included in mill wide sulphur from all sources excluding power boiler	
	H ₂ SO ₄ Mist	mg SO ₃ /NDm ³	Twice Yearly	-	Included in mill wide sulphur from all sources excluding power boiler	
CNCG emergency incinerator	TRS	mg H ₂ S/NDm ³		-	Included in mill wide sulphur from all sources excluding power boiler	
	NO _x	mg NO ₂ /NDm ³	To be calculated	-	Included in mill wide NO _x from all sources excluding power boiler	
	SO ₂	mg S/NDm ³	To be calculated	-	Included in mill wide sulphur from all sources excluding power boiler	

Emission Source	Pollutant	Units	Testing Frequency	Annual Average Limit	Monthly Average Limit	Comments
	SO ₂ +SO ₃	mg S/NDm ³	To be calculated	-	Included in mill wide sulphur from all sources excluding power boiler	
Power Boiler	PM	mg/NDm ³	Monthly initially then less frequent depending on results	-	30 @ 8% O ₂	Manual testing
	NO _x	mg NO ₂ ^{/MJ} fuel input	Continuous	-	80	Monthly average not included in mill wide NO _x from all sources
		mg NO ₂ /NDm ³	Continuous	-	~200 @ 8% O ₂	
	SO ₂	mg S/NDm ³	Continuous	-	Monthly average dependent on fuel sulphur content.	Not included in mill wide sulphur from all sources
	PCDD/PCDF	pg I-TEQ/NDm ³	Quarterly 1st year operation Twice yearly thereafter	-	100 @ 8% O ₂	Average over sampling period 4-8 hours
All Sources	Sulphur	Kg S/ADt	Continuous	0.4	-	Continuous and Manual Testing Includes lower strength sulphur point sources
	NO _x	mg NO ₂ /NDm ³	Continuous	1.3		Continuous and Manual Testing Includes lower strength NO _x point sources
	H ₂ SO ₄ Mist	mg SO ₃ /NDm ³	Twice Yearly	-	Included in mill wide sulphur from all sources excluding power boiler	
	Hydrogen chloride (HCl)	mg HCl/NDm ³	Continuous	-	Included in chlorine dioxide and related compounds from all sources	

Emission Source	Pollutant	Units	Testing Frequency	Annual Average Limit	Monthly Average Limit	Comments
	Odour	mg H ₂ S/NDm ³	Dependent on spot monitoring program	-	Included in mill wide sulphur from all sources excluding power boiler	Proponent required to conduct 12 month odour monitoring program
	Inorganic chlorinated compounds	mg Cl ₂ /NDm ³	Continuous	-	50	

4.3.2 Effluent Treatment and Discharge

Introduction

The proposed Kraft pulp mill will use the Elemental Chlorine Free (ECF) process for bleaching the pulp product, which will result in the production of a raw effluent.

The project will be designed to both reduce the volume of effluent and to treat the raw effluent, within an Effluent Treatment Plant before release to an ocean outfall site. The Effluent Treatment Plant will comprise a primary and secondary treatment facility, with the biological treatment featuring an extended aeration activated sludge process, following an integrated anoxic chlorate removal stage and a two-stage selector part. This plant would process 37,720 m³ of effluent per hour, and approximately 33,660 tonnes of treated effluent would be released per day. The treated effluent would be discharged to the ocean offshore of Five Mile Bluff on the coast of Bass Strait, via an effluent pipe fitted with a multi-port diffuser system.

Monitoring Program Schedule

An effluent monitoring program will be implemented within the Effluent Treatment Plant at the pulp mill site. The schedule for monitoring is detailed in Table 6. The effluent discharge limits for the pulp mill are defined in the RPDC Emission Limit Guidelines and the *ANZECC & ARMCANZ (2000) Australian Guidelines for Water Quality Monitoring and Reporting*. The sampling schedule for the effluent treatment and discharge point will be determined in accordance with any approval issued for the project, and to the satisfaction of DTAE.

Table 6: Effluent Monitoring Program – Indicative Core Chemical, Biological and Other Parameters. NOTE finally suite and sampling frequency to be determined by DTAE.

Parameter	Units	Frequency of Testing ¹	Monthly Average Limit	Daily Limit	Limit at time of testing
Physical and Chemical					
Flow		Continuous			
Temperature	°C	Continuous	-	-	-
TSS	kg/d	Daily	8320	14,400	-
COD	kg/d	Daily	64,000	108,800	-
BOD ₅	kg/d	3 times weekly	6720	11,520	-
Colour	kg/d	Daily	134,400	230,400	-
Oil and grease	-	Daily	-	-	No visible contamination
Trihalomethanes					
Chloroform	mg/L	Monthly	-	2	-
		Quarterly			

Parameter	Units	Frequency of Testing ¹	Monthly Average Limit	Daily Limit	Limit at time of testing
Bromodichloromethane	-	-	-	-	-
Dibromochloromethane	-	-	-	-	-
Bromoform	-	-	-	-	2
Organochlorine	-	-	-	-	-
Chlorine compounds, including persistent organic pollutants (POPs)-to be determined in consultation with DPIWE	-	-	-	-	-
Phenolic Compounds –	-	-	-	-	-
To be determined in consultation with DPIWE					
Metals					
Iron	-	-	-	-	-
Aluminium	-	-	-	-	-
Arsenic	-	-	-	-	-
Barium	-	-	-	-	-
Chromium	-	-	-	-	-
Copper	-	-	-	-	-
Magnesium	-	-	-	-	-
Manganese	-	-	-	-	-
Mercury	-	-	-	-	-
Zinc	-	-	-	-	-
Other parameters	-	-	-	-	-
AOX	kg/d	Weekly	640	1280	
Acute Effluent Toxicity					
-on 100% effluent	LC ₅₀ /EC ₅₀				The effect from the effluent should be less than 50%
Microtox®		Weekly			
Invertebrate & vertebrate		Monthly			
Chronic Toxicity	EC ₅₀	Quarterly	-	-	-
2,3,7,8-TCDD	pg/L	Monthly	-	-	10
		Quarterly			
2,3,7,8-TCDF	pg/L	Monthly	-	-	30

Parameter	Units	Frequency of Testing ¹	Monthly Average Limit	Daily Limit	Limit at time of testing
		Quarterly			
Chlorate	mg/L	Monthly	-	-	10
		Quarterly			

² Measured at various dilutions above and below the expected dilution at the mix zone. The concentration at which 50% effect is obtained, the Lowest Observed Effect Concentration (LOEC) and the No Observed Effect Concentration (NOEC) should be determined and discharge limit set such that NOEC is not exceeded at edge of mixing zone.

Monitoring Methodology

Wastewater will be sampled at the point immediately prior to discharge into the effluent pipeline from the Effluent Treatment Plant, but will exclude any uncontaminated water (such as indirect cooling water), as defined by the RPDC Emission Limit Guidelines. A suitably qualified person at the pulp mill control room will download the data for comparative analysis against emission limits.

Water quality samples will be collected for laboratory analysis using an auto sampler. The sampler uses flow weighting in its sampling protocol to take 24-hour composite samples, according to the required frequency for each parameter as specified in Table 3. A suitably qualified person will collect the samples. Sample collection, handling, storage and dispatch procedures will be in accordance with the *ANZECC & ARMCANZ (2000) Australian Guidelines for Water Quality Monitoring and Reporting* and *AS 5667.1:1998 Water Quality – Sampling – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*. The samples will then be sent, under appropriate quality control storage and handling conditions, to a NATA registered laboratory or a laboratory approved by the Director for analysis (see Section 4.7 for more details). Parameters will be tested in accordance with the test methods specified in Table 7 and Table 9 of the RPDC Emission Limit Guidelines or other equivalent or better methods approved by the Director.

Continuous monitoring of colour BOD₅, COD and temperature will be investigated as an option to sampling and laboratory analyses. Monthly sampling of TSS, BOD₅, and COD will be analysed at a NATA-certified laboratory. This sampling will act as a quality assurance procedure, designed to check the accuracy of the automated water quality instrumentation should they be installed.

A suitably qualified person will undertake regular maintenance of the automatic data logger in accordance with manufacturers specifications. During periods of maintenance, or in the event of a failure of the automatic data logger, daily samples for TSS, BOD₅, COD and temperature will be taken until the automatic logger is confirmed to be recording accurate samples.

A suitably qualified person will assess all analytical results against the discharge limits. Weekly and monthly reports containing all data and analytical results will be prepared and submitted to the Gunns Environmental Manager (or delegate) of the project. All analytical data collected over the financial year will also be included in an Annual Report and provided to the Director (see Section 4.7 for more details).

4.4 Ambient Monitoring

4.4.1 Introduction

The RPDC Emission Limit Guidelines require an ambient environmental monitoring program to be designed and implemented 2.5 years prior to commissioning and post commissioning of the project to assess the mill's ability to meet specified ambient criteria for air quality, water quality and biological condition. Pre-operational and operational monitoring shall measure the same parameters, under the same methodology, at the same frequencies, to obtain best statistical outcome. Sampling methodologies and frequencies will be reviewed in line with BPEM principals

Components of the ambient monitoring program will include:

- ▶ Air quality (meteorological and air quality);
- ▶ Odour;
- ▶ Noise;
- ▶ Water quality (leachate, surface and groundwater); and
- ▶ Receiving environment water quality (estuarine and marine).

4.4.2 Atmospheric Environmental Monitoring

Atmospheric Environmental Monitoring shall commence 2.5 years prior to plant commissioning. The operational phase of the monitoring program will commence following the commissioning of the pulp mill operations, and will encompass the methodologies and sampling design adopted for pre operational monitoring studies. This will ensure accurate data comparison and statistical rigour of the operational monitoring program. The monitoring program will only be implemented after agreement by all regulatory authorities and shall include:

- ▶ Meteorological and Air Quality Monitoring;
- ▶ Monitoring of Dairy Produce; and
- ▶ Odour Monitoring.

Meteorological and Air Quality Monitoring

The parameters that must be recorded at the meteorological station are defined in the RPDC Emission Limit Guidelines (Section D.3.6), and have been determined in accordance with *AS 2923-1987 Ambient air - Guide for measurement of horizontal wind for air quality applications*. These are:

- ▶ Wind speed;
- ▶ Wind direction;
- ▶ Standard deviation of wind direction;
- ▶ Air temperature;
- ▶ Temperature differential between 10 and 2 m;
- ▶ Humidity;

- ▶ Incoming short-wave solar radiation;
- ▶ Net solar radiation; and
- ▶ Rainfall.

These parameters are measured at a meteorological station maintained by Comalco Aluminium Pty Ltd, which is close and in the same airshed as the proposed pulp mill. The data from this station was used for the air dispersion modelling.

A single surface meteorological station and an air quality monitoring station was established at Rowella in July 2005 in accordance with AS 2923 and AS 2922-1987-*Ambient Air Guide for Siting of Sampling Units*, to record wind speed and direction, air temperature, relative humidity, sulphur dioxide, nitrogen dioxide, total reducible sulphur and particulate matter (PM10). The monitoring station is on the western side of the Tamar River, opposite the existing Gunns Longreach chip mill and in the vicinity of Van Diemens Aquaculture facility. This station is maintained by a NATA accredited consultancy, operates continuously and will be maintained and commissioned throughout the pulp mill's operational phase.

Table 7 presents details of the parameters to be recorded, frequency of sampling and emission limits at the air quality station(s), as defined by the RPDC Emission Limit Guidelines. Discussions with DTAE are required to develop and clarify the sampling schedule for the ambient air monitoring program. The meteorological component of the station at Rowella will soon monitor all meteorological parameters detailed in the guideline hence reducing reliance on the Comalco Bell Bay data.

Table 7: Ambient Air Quality Monitoring Schedule

Parameter	Frequency of Sampling	Concentration Limit	Averaging Time	Allowed Exceedence	Source
SO ₂ + SO ₃	-	-	-	-	-
SO ₂ Sulphur dioxide	-	200 µg/Nm ³	1 hr (moving av)	None	RPDC
SO ₂	Continuous	0.20 ppm (570 µg/Nm ³)	1 hr	0.1 %	DPIWE
H ₂ SO ₄ Mist	6 monthly	-	-	-	-
Total Reduced Sulphides (TRS)	Continuous	1.5 µg/Nm ³	3 min (moving av)	None	RPDC
HCl	Continuous	200 µg/Nm ³	3 min	0.1%	DPIWE
Cl ₂	Continuous	-	-	-	-
ClO ₂	Continuous	10 µg/Nm ³	3 min	0.1 %	DPIWE
Inorganic chlorinated compounds	Continuous	-	-	-	-
Chlorinated dioxins and furans	Quarterly for first 12 months, then twice yearly	-	-	-	-
NO ₂ Nitrogen Dioxide	Continuous	160 µg/Nm ³	1 hr (moving av)	None	RPDC

Parameter	Frequency of Sampling	Concentration Limit	Averaging Time	Allowed Exceedence	Source
Dioxide			av)		
NO ₂	Continuous	0.6 ppm (328 µg/Nm ³)	1 hr	0.1% (9 hrs/year)	DPIWE
PM10	Monthly	150 µg/Nm ³	24 hr	None	DPIWE
Particulate Matter <10 µm					
Odour		2 odour unit	1 hr	0.5 %	

DPIWE refers to the *Environment Protection Policy (Air Quality) 2004*

RPDC refers to the *RPDC Emission Limit Guidelines*

The methodology for conducting the air quality monitoring follows that described in *Environment Protection Policy (Air Quality) 2004*. Real time gas analysers¹ are used to measure sulphur dioxide, nitrogen dioxide, and total reduced sulphur. Particulates less than 10 microns in diameter are continuously monitored using a specially adapted TEOM².

Inorganic chlorinated compounds, in the form of chloride, are presently being monitored at the Air Quality Station by analysing dust particulates of <2.5 microns in diameter which are collected on a filter over a two day period each week. A specialist consultant manages the station and reports weekly PM 2.5 as well as the chemical composition of the particulates. They calculate the percentage of inorganic chlorinated compounds (sea salt) in the particulates.

Other inorganic chlorinated compounds are hydrogen chloride, chlorine dioxide and chlorine. A continuous monitoring system is under investigation, which is capable of monitoring these as well as sulphur trioxide in the ambient environment. Sulphuric acid mist shall be determined six monthly using a discrete wet chemical method.

Dioxin and furan measurements in ambient air are based on USEPA TO-9A. It involves collection of chemicals from ambient air onto a filter and polyurethane foam (PUF) cartridge using a high volume sampler. The sampler is operated at 225 to 280 l/min for normally 24 hours however this period can be increased in a clean environment. For example Department of Environment and Heritage National Dioxin Program sampled at monthly intervals over twelve months. The pre filter for particulate dioxin/furan was changed weekly and combined with the PUF. The pre filter and PUF are analysed together by a NATA accredited laboratory. It is proposed that dioxin and furan monitoring shall involve a sampling event every month at the Rowella Air Quality Station with ongoing review of the data.

¹ SULPHUR DIOXIDE -the monitor is an ultra violet fluorescence spectrometer designed to continuously measure low levels of sulphur dioxide in ambient air. The USEPA has designated this analyser as an equivalent method.

OXIDES OF NITROGEN ANALYSER- the monitor uses gas phase chemiluminescence detection to perform continuous analysis of nitric oxide, total oxides of nitrogen, and nitrogen dioxide. The USEPA has designated this analyser as an equivalent method.

² TEOM PARTICULATE MONITOR- The TEOM is a true gravimetric instrument that draws air through a filter at a constant flow rate, continuously weighing the filter and calculating near real time (10 min) mass concentrations.

The weighing principal is similar to a microbalance

Calibration, maintenance, and initially data management of all environmental monitoring instruments shall be outsourced to a NATA accredited consultancy.

All data logged by the meteorological and air quality stations will be managed by a suitably qualified person and assessed against the emission limits detailed in Table 7:. Monthly reports will be prepared for the Gunns' Environmental Manager (or delegate) for review. All analytical data collected over the financial year will also be included in an Annual Report and provided to the Director (see Section 4.7 for more details).

Monitoring of Dairy Produce

Appendix F of the Final Scoping Guidelines suggests monthly testing over four months of cow's milk from cows grazing on pasture within the regional airshed.

Gunns accepts the suggestion as a means of assessing ambient levels of dioxins in cow's milk, and repeating the study after commencement of mill operations to ascertain impact. It is predicted that there will be no change because of the ECF mill technology.

Milk sampling locations will be determined by assessing the prevailing wind direction for each season. Within each sampling run a dairy close to and distant from the mill site, and within the regional airshed will be selected. One sample of cow's milk from each dairy shall be collected within each quarter, to take into account seasonal variation, over one year.

To ensure samples are representative of the daily milk production cycle samples will be collected from mixed/cooled bulk tanks at the end of each day. The tanks will be agitated for a minimum of 15 minutes prior to sampling to ensure the homogenous nature of the milk is not compromised. Samples will be taken by an appropriately qualified person, from the outflow valve at the base of the tank into pre-treated sample bottles provided by a NATA registered laboratory. The samples will then be sent, under appropriate quality control storage and handling conditions, to a NATA registered laboratory or a laboratory approved by the Director (see Section 4.7 for more details) for dioxin analysis. At the time of sampling relevant information including source feed, cow breed, number of cows currently milked, number of cows in their first milk cycle and where the milk is to be shipped will be recorded.

Sampling techniques and frequency will be reviewed in accordance with BPEM principals.

Statistical analysis will be undertaken once data has been recorded. Analysis and interpretation of data will require a range of sophisticated statistical techniques necessary to determine the significance of spatial and temporal differences observed in target parameters recorded during the operational phase.

Odour Monitoring

Odour Diaries

The odour monitoring program is defined by the RPDC Emission Limit Guidelines. A specialist consultant shall assist with the development of this program. It involves the establishment of a panel of at least 10 local residents who could potentially be affected by any odour emissions from the project, and are willing to be trained to provide regular systematic feedback on:

- ▶ The type of any nuisance odours emanating from the mill that are detectable on their properties, and

- ▶ The level of any nuisance odours detected at their property.

The residents will be selected in consultation with a community liaison group that has been previously established in the area, and will be asked to keep diaries of unusual odour events at their properties.

In accordance with the *Good Practice Guide for Assessing and Managing Odour in New Zealand* (June 2003), the information to be recorded in the diary programme includes:

- ▶ Date and time of day;
- ▶ Duration of the event;
- ▶ Continuity of the odour during the event;
- ▶ Character and strength of odour;
- ▶ Likely source of odour; and
- ▶ Wind direction and strength.

Diarists should be given instructions on how to record information, so that it is as consistent as possible. They should also be given feedback on the programme to help maintain their enthusiasm to continue keeping the records.

Odour Monitoring On-site

In accordance with the RPDC Emission Limit Guidelines, odour monitoring will also be conducted within the mill. The mill operator will utilise at least one portable gas chromatograph – mass spectrometer (or instrumentation of similar or greater sensitivity and utility) and will utilise it to characterise, identify, locate and minimise diffuse sources of Total Reduced Sulphides (TRS) odour within the mill.

A site diary will be maintained when odour complaints from employees are received, it will record the same information as the diary programme for local residents.

Additionally during the 2.5 year pre-operational monitoring program existing characterisation of odour sources within the local airshed shall be achieved utilising a portable gas chromatograph/mass spectrometer. A comprehensive list of potential sources shall be developed in consultation with DTAE and a specialist consultant. Potential sources include :- fish farm (morts), exposed mud along the Tamar Estuary, agricultural, industrial sources, sewage treatment and refuse disposal site.

Typical seasonal variation of sources and odour composition shall be assessed over two days each season. Discrete nature of the sampling means that at the time of sampling the odour may not be as concentrated as at another time eg inversion, but the composition is likely to be the same. Hence this program is designed to characterise the existing odour sources prior to mill start up.

4.4.3 Noise Monitoring

A noise monitoring program, as part of the noise management strategy is recommended once the pulp mill and additional chipper are operational with specific engineering noise controls in place.

The emission limits, as defined by DTAE for the existing Gunns operated chip mill, state that:

The noise emissions from the activity on the land, when measured at any residential premises in other ownership, and expressed as the adjusted time weighted average A weighted sound pressure level must not exceed:

55 dB(A) between 0700 to 1800

50 dB(A) between 1800 to 2200

45 dB(A) between 2200 to 0700

Occupational health and safety requirements also stipulate that workers are not to be exposed to noise levels exceeding 85 dB(A) for 8 hour durations.

It has been suggested that engineered acoustic attenuation be implemented for primary noise sources located outdoors. It is also recommended that the sound power levels for any items of plant or machinery to be used on site does not exceed levels that the project has been currently modelled for.

It is proposed to initially install two continuous noise monitors to assess:-

- i. Ambient levels prior to commencement of site preparation;
- ii. Monitoring of noise emissions during site preparation and construction; and
- iii. Ongoing environmental noise during commissioning and normal operation of plant.

The locations of these monitors will be decided in consultation with DTAE.

The instrument proposed for use at both sites would be a Type 1 sound level meter with an extensive range measurement, logging and communication capabilities.

In association with this, insitu attended noise monitoring shall occur at a number of nearby residences during each of the four seasons over 2.5 years before mill start up.

A specialist consultant shall facilitate this program.

4.4.4 Ocean Outfall Monitoring

Introduction

The treated effluent from the Pulp Mill will be discharged to Bass Strait via a multi-port diffuser system approximately 3 kilometres off the northern coast of Tasmania at Five Mile Bluff.

Marine monitoring at the proposed outfall site shall commence 2.5 years prior to plant commissioning. The operational phase of the monitoring program will commence following the commissioning of the pulp mill operations, and will encompass the methodologies and sampling design adopted for baseline and pre operational monitoring studies. This will ensure accurate data comparison and statistical rigour of the operational monitoring program. The monitoring program will only be implemented after agreement by regulatory authorities.

The outfall monitoring area has been classified as a 'slightly to moderately disturbed system'. The biological communities associated with the area are in a healthy condition and ecosystem integrity is

largely retained, however due to the proximity to the Tamar River and its associated agricultural run-off the area is likely to be adversely effected to a small but measurable degree.

Baseline monitoring has indicated that the relationships between physical and chemical indicators and biological responses are influenced by seasonal effects. In accordance with the ANZECC guidelines seasonal monitoring has been undertaken and trigger values will be developed based on the outcomes of 10 seasonal monitoring events over the next 2.5 years.

A suite of analytes have been selected that have historically shown potential to be found in elevated levels associated with the waste stream produced by pulp mills. Baseline surveys allow site-specific trigger values to be developed using the 80th percentile of a combination of local biological effects data (eg multiple species toxicity tests) and local reference data. By using the 80th percentile of the reference distribution it avoids the need to specify an absolute quantity and allows the trigger criterion to be constantly updated to reflect the temporal trends and the effects of extraneous factors (ANZECC, 2000). These trigger values are currently considered interim working levels and will be updated quarterly as more data becomes available.

4.4.5 Determination of Trigger Values

Trigger values are concentrations that when reached, indicate a potential environmental problem, and so 'trigger' a management response (ANZECC, 2000).

Trigger values have been determined using those pre-existing in the ANZECC guidelines, where possible, however where statistical analysis of the results gave a ambient concentration that exceeded the trigger value then the 80th percentile of the ambient concentration has been adopted as the site specific trigger value. By using the 80th percentile of the reference distribution it avoids the need to specify an absolute quantity and allows the trigger criterion to be constantly updated to reflect the temporal trends and the effects of extraneous factors (ANZECC, 2000). These trigger values are currently considered interim working levels and will be updated quarterly as more data becomes available.

The State Policy on Water Quality Management accepts that within the mixing zone these water quality objectives may not be achieved however it must not cause:

- ▶ Objectionable odours which would adversely affect the use of the surrounding environment;
- ▶ Objectionable discolouration at the surface of the mixing zone, which could adversely affect the use of the surrounding environment;
- ▶ Visible floating foam, oils, grease, scum, litter or other objectionable matter
- ▶ Mortality of fish or other aquatic vertebrates; or

Fish or other aquatic organisms used for human consumption to become unacceptable for such use as determined by Tasmanian health standards.

Monitoring Design

In accordance with the RPDC Emission Limit Guidelines, the monitoring program will be a multi disciplinary design that monitors the quality and condition of water, sediment, biota and ecological

communities adjacent to the ocean discharge outfall during operations. Prescriptive components of the monitoring program such as chemical and biological parameters, sampling frequency and sampling locations have not been included in the main body of the document. These components will only be implemented into the monitoring program following agreement with RPDC and DTAE once data from baseline and pre operational monitoring programs have been collated and reviewed.

Indicative parameters (potential pollutants from pulp mill effluent) and sampling frequencies stipulated by RPDC are presented in Table 5 and should be used as a guideline when deciding on appropriate parameters for the program. As required by the RPDC Emission Limit Guidelines, the test methods employed by Gunns will be the same as, equivalent to or better than the suggested test methods in Tables 7 and 9 of the RPDC Emission Limit Guidelines. If pre operation monitoring identifies contamination from another source at the study site, then the monitoring program will need to be able to differentiate between contamination from the outfall and contamination from another source. This may require monitoring additional parameters to quantify any impact.

Development of the Monitoring Programs: Staged Approach

Development of an integrated multidisciplinary monitoring program for each matrix identified in the RPDC Emission Limit Guidelines (2004) requires a staged approach. This is summarised accordingly:

- ▶ Stage 1: 2.5 year pre-operational monitoring.
- ▶ Stage 2: Review existing baseline data associated with each component of the monitoring program;
- ▶ Stage 3: Identify and confirm target parameters suitable for inclusion into the monitoring program;
- ▶ Stage 4: Design each component of the monitoring program to meet the statistically rigorous objectives of the program;
- ▶ Stage 5: Obtain regulatory approval for the monitoring program; and
- ▶ Stage 6: Implement the monitoring program (data collection, analysis and reporting). Methodology for conducting the monitoring program should follow that described in *Protocols for marine ecological monitoring programs associated with BEK mills*, by M.J. Keough and B.D. Mapstone (1995), National Pulp Mills Research Program Technical Report No. 11.

The monitoring program has been separated into individual matrix components and comprise of the following:

- ▶ Water;
- ▶ Sediment;
- ▶ Biota; and
- ▶ Ecological communities.

Methodology

The proposed methodology for each component of the monitoring program has been designed in accordance with requirements detailed in the RPDC Emission Limit Guidelines.

Each component of the monitoring program will be designed and implemented as per the staged process discussed in Section 02. It is accepted that each component will be subject to the requirements outlined

in Stage 1, Stage 2 and Stage 5. As such, the focus of the following methodology sections is primarily towards the conduct of Stages 3 - 4.

Water Quality Monitoring

Stage 1

It is proposed to collect water samples from two locations in the vicinity of the diffuser as well as from two remote control locations. Actual locations shall be determined in consultation with DTAE and DPIW. Mid season surface, mid-column and bottom column waters will be collected from each site and analysed for analytes detailed in Table 8. In summary this comprises of 12 samples per season, or 48 samples per year. Refer Stages 2 to 6 for further detail. A specialist consultant with documented sampling procedures shall be responsible for sample collection while NATA accredited laboratories shall undertake the analyses.

Stage 2 and 3

Critical assessment of the data recorded during baseline and pre operation monitoring will identify background receiving water conditions at the outfall site. Background data from these monitoring programs and further consultation with DTAE will ensure that target parameter selection (stage 3), sampling design (stage 4), approval process (stage 5) and program implementation (stage 6) are correctly developed and undertaken.

Target parameters will be selected for the operational monitoring program through consultation with DTAE.

Stage 4 & 5

The proposed receiving waters monitoring program will be designed in compliance with requirements of the following documents as specified in the RPDC Emission Limit Guidelines:

- ▶ Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting (ANZECC and ARMCANZ 2000);
- ▶ Tasmanian *State Policy on Water Quality Management 1997* for the discharge site for a specific pulp mill proposal; and
- ▶ Protocols for designing marine ecological monitoring programs associated with BEK mills.

Other useful guidance documents include AS/NZS 5667.9:1998, Water quality - Sampling - Guidance on sampling from marine waters

Several key tasks will be undertaken to facilitate development of an appropriate receiving waters monitoring program and to obtain the necessary regulatory approvals. Unless engineering design conditions change between pre operation monitoring and operation monitoring, sampling stations and methodology for the operational monitoring program should remain the same as baseline and pre operation sampling stations. Additional sampling stations may be required to adequately define the mixing zone boundaries. If the discharge output design changes between initiation of the pre operation monitoring program and operation phases, then hydro-dynamic re-modelling of the discharge plume should be undertaken in order to ascertain new discharge dispersion animations at the outfall. Review of

discharge animations over a range of scenarios will enable re selection of appropriate locations for potential impact receiving water quality sampling stations, in accordance with RPDC Emission Limit Guidelines.

It is anticipated that water samples will be collected from three profiles within the water column, namely: surface, mid-column and bottom column waters.

Receiving water monitoring requirements (parameters and frequency of monitoring) are stipulated in the RPDC Emission Limit Guidelines as per Table 5. Best practice procedures dictate that physicochemical water quality data (pH, redox, salinity, turbidity, temperature and dissolved oxygen) would also be collected during each receiving water quality sampling event.

A high level of statistical rigor is desired for the water quality component of the monitoring program. An analysis of the baseline and pre operation monitoring data will guide the spatial separation and degree of replication of the sampling program.. The best practicable design will be adopted for the operational monitoring program to ensure that statistical inference will be maximised.

It is anticipated that a balanced nested monitoring before, after, control and impact sample design will be employed for all components of the receiving water monitoring program. This design incorporates equal number of control and impact stations, which enables assessment of within-site variation between site variation among both control and impact locations and comparison of variation between both impact and control locations.

Regulatory agency approval will be sought prior to program implementation.

During the design phase Gunns will ensure that DTAE's requirements are incorporated into the monitoring program. Specifically that:

- ▶ *Selection of the number and location of control sites is an integral part of the design of the monitoring program and should be considered during the design phase, in consultation with regulatory authorities. Control sites should be outside the zone of influence of the mill, but in areas with closely matched oceanographic, sedimentary and biological characteristics where that is feasible; and*
- ▶ *Sampling must facilitate the determination of natural spatial, seasonal and interannual variation in the biological characteristics of the area. The survey design must therefore facilitate sound statistical analysis of variations in measured parameters. Replication levels will need to be determined on the basis of the preliminary survey.*

Stage 6

Water sampling methods should be identical to pre operation monitoring methods. It is envisaged that water samples collected for chemical analysis will be obtained using a Niskin sampler. Physiochemical parameters will be measured using a Yeokal logger, or similar, at pre specified depths. All samples will be collected, stored and analysed under strict QA/QC protocol (Section 0).

Statistical analysis will be undertaken once data has been recorded. Analysis and interpretation of data will require a range of statistical techniques necessary to determine the significance of spatial and temporal differences observed in target parameters recorded during the operational phase.

Table 8: Effluent Outfall Monitoring Program- Marine Water

Analyte	Unit	Detection Limit	Assessment Criteria	Analyte	Unit	Detection Limit	Assessment Criteria		
			Interim 95% Protection				Interim 95% Protection		
Sample Date				Sample Date					
Dissolved Heavy Metals	Aluminium	µg/L	10	20	Miscellaneous	Suspended Solids (SS)	mg/L	1	32
	Selenium	µg/L	2	2		Colour (True)	PCU	1	7
	Iron	µg/L	5	19		pH	pH Unit	0.01	8.27
	Antimony	µg/L	0.5	<0.5		Oil & Grease	mg/L	5	7
	Arsenic	µg/L	0.5	2.5		Chemical Oxygen Demand	mg/L	5	2360
	Barium	µg/L	1	7		Biochemical Oxygen Demand	mg/L	2	3
	Beryllium	µg/L	0.1	<0.1		AOX	µg/l	2	46
	Bismuth	µg/L	0.1	<0.1		Chlorate	mg/l	2	<2
	Boron	µg/L	100	6100		Electrical conductivity	µS/cm	1	62900
	Cadmium	µg/L	0.2	*5.5		Salinity	g/kg	4	41
	Chromium	µg/L	0.5	*27.4		Dissolved Oxygen	mg/L	0.1	9.1
	Cobalt	µg/L	0.2	*1		Carbon disulfide	µg/L	5	<5
	Copper	µg/L	1	*1.3		Naphthalene	µg/L	7	<7
	Lead	µg/L	0.2	*4.4		Anionic Surfactants as MBAS	mg/L	0.1	0.1
	Lithium	µg/L	1	191		1,3,5-Trichlorobenzene	µg/L	2	<2
	Manganese	µg/L	0.5	3.3		1,2,4,5-Tetrachlorobenzene	µg/L	2	<2
	Molybdenum	µg/L	0.1	12.6		Methanesulfonate methyl	µg/L	2	<2
Nickel	µg/L	0.5	*70	Methanesulfonate ethyl	µg/L	2	<2		

	Silver	µg/L	0.1	*1.4		cis-Isosafrole	µg/L	2	<2
	Strontium	µg/L	10	8580		trans-Isosafrole	µg/L	2	<2
	Tellurium	µg/L	0.5	4.6		Safrole	µg/L	2	<2
	Thallium	µg/L	0.1	1.3		Diallate	µg/L	2	<2
	Thorium	µg/L	0.1	0.3		2,3,4,6-Tetrachlorophenol	µg/L	2	<2
	Tin	µg/L	5	<5		Benzene	µg/L	5	*700
	Titanium	µg/L	5	687		Toluene	µg/L	5	<5
	Uranium	µg/L	0.1	3.5		Ethylbenzene	µg/L	5	<5
	Vanadium	µg/L	0.5	*100		meta- & para-Xylene	µg/L	5	<5
	Zinc	µg/L	5	*15		Styrene	µg/L	5	<5
	Mercury	µg/L	0.1	*0.4		ortho-Xylene	µg/L	5	<5
	Dioxins & Furans	Tetra-dioxins	pg/L	5		25.2	Isopropylbenzene	µg/L	5
Penta-dioxins		pg/L	25	220.2	n-Propylbenzene	µg/L	5	<5	
Hexa-dioxins		pg/L	25	670.5	1,3,5-Trimethylbenzene	µg/L	5	<5	
Hepta-dioxins		pg/L	25	259.8	sec-Butylbenzene	µg/L	5	<5	
Octa-dioxin		pg/L	50	528.7	1,2,4-Trimethylbenzene	µg/L	5	<5	
Tetra-furans		pg/L	5	29.9	tert-Butylbenzene	µg/L	5	<5	
Penta-furans		pg/L	25	396.5	p-Isopropyltoluene	µg/L	5	<5	
Hexa-furans		pg/L	25	921.9	n-Butylbenzene	µg/L	5	<5	
Hepta-furans		pg/L	25	443.7	2,2-Dichloropropane	µg/L	5	<5	
Octa-furans		pg/L	50	543.1	1,2-Dichloropropane	µg/L	5	<5	
	Σ PCDD/Fs	pg/L	0	4039.6	cis-1,3-Dichloropropylene	µg/L	10	<10	
Halogenated Aromatic Compounds	Chlorobenzene	µg/L	5	<5	trans-1,3-Dichloropropylene	µg/L	10	<10	
	Bromobenzene	µg/L	5	<5	1,2-Dibromoethane (EDB)	µg/L	5	<5	
	2-Chlorotoluene	µg/L	5	<5	Bolstar	µg/L	1	<5	
	4-Chlorotoluene	µg/L	5	<5	Chlorpyrifos	µg/L	1	*0.009	
	1,3-Dichlorobenzene	µg/L	5	<5	Coumaphos	µg/L	1	<5	
					Organophosphorus Pesticides				

	1.4-Dichlorobenzene	µg/L	5	<5				
	1.2-Dichlorobenzene	µg/L	5	<5				
	1.2.4-Trichlorobenzene	µg/L	5	<5				
	1.2.3-Trichlorobenzene	µg/L	5	<5				
Anilines and Benzidines	Aniline	µg/L	2	<2				
	4-Chloroaniline	µg/L	2	<2				
	2-Nitroaniline	µg/L	4	<4				
	3-Nitroaniline	µg/L	4	<4				
	Dibenzofuran	µg/L	2	<2				
	4-Nitroaniline	µg/L	2	<2				
	Carbazole	µg/L	2	<2				
	3,3'-Dichlorobenzidine	µg/L	2	<2				
Acid Herbicides	2.4-D	µg/L	1	<5				
	2.4-DB	µg/L	1	<5				
	2.4.5-T	µg/L	1	<5				
	2.4.5-TP	µg/L	1	<5				
	Actril (loxynil)	µg/L	1	<5				
	Dicamba	µg/L	1	<5				
	Dichlorprop	µg/L	1	<5				
	Dinitro-o-cresol	µg/L	1	<5				
	Dinoseb	µg/L	1	<5				
	MCPA	µg/L	1	<5				
	MCPB	µg/L	1	<5				
	Mecoprop	µg/L	1	<5				
	Warfarin (surr.)	%	1	100				
	Nitrosamines	N-Nitrosomethylethylamine	µg/L	2	<2			
N-Nitrosodiethylamine		µg/L	2	<2				
	Demeton-O	µg/L	1	<5	Organochlorine Pesticides			
	Diazinon	µg/L	1	<5				
	Dichlorvos	µg/L	1	<5				
	Disulfoton	µg/L	1	<5				
	Ethion	µg/L	1	<5				
	Ethoprop	µg/L	1	<5				
	Fenitrothion	µg/L	1	<5				
	Fensulfthion	µg/L	1	<5				
	Fenthion	µg/L	1	<5				
	Merphos	µg/L	1	<5				
	Methyl azinphos	µg/L	1	<5				
	Methyl parathion	µg/L	1	<5				
	Mevinphos	µg/L	1	<5				
	Naled	µg/L	1	<5				
	Phorate	µg/L	1	<5				
	Ronnel	µg/L	1	<5				
	Tokuthion	µg/L	1	<5				
	Trichloronate	µg/L	1	<5				
	Triphenylphosphate (surr.)	%	1	120				
	DEF	%	0.1	109				
	4 4'-DDD	µg/L	0.1	<0.1				
	4 4'-DDE	µg/L	0.1	<0.1				
	4 4'-DDT	µg/L	0.1	<0.1				
	a-BHC	µg/L	0.1	<0.1				
	Aldrin	µg/L	0.1	<0.1				
	b-BHC	µg/L	0.1	<0.1				
	Chlordane	µg/L	0.5	<0.2				

	N-Nitrosopyrrolidine	µg/L	4	<4		d-BHC	µg/L	0.1	<0.1
	N-Nitrosomorpholine	µg/L	2	<2		Diadrin	µg/L	0.1	<0.1
	N-Nitrosodi-n-propylamine	µg/L	2	<2		Endosulfan I	µg/L	0.1	<0.1
	N-Nitrosopiperidine	µg/L	2	<2		Endosulfan II	µg/L	0.1	<0.1
	N-Nitrosodibutylamine	µg/L	2	<2		Endosulfan sulphate	µg/L	0.1	<0.1
	N-Nitrosodiphenyl & Diphenylamine	µg/L	4	<4		Endrin	µg/L	0.1	*0.008
	Methapyrilene	µg/L	2	<2		Endrin aldehyde	µg/L	0.1	<0.1
	1.4-Dichlorobenzene	µg/L	2	<2		Endrin ketone	µg/L	0.1	<0.1
	1.3-Dichlorobenzene	µg/L	2	<2		g-BHC (Lindane)	µg/L	0.1	<0.1
	1.2-Dichlorobenzene	µg/L	2	<2		Heptachlor	µg/L	0.1	<0.1
Chlorinated Hydrocarbons	Hexachloroethane	µg/L	2	<2	Heptachlor epoxide	µg/L	0.1	<0.1	
	1.2.4-Trichlorobenzene	µg/L	2	*80	Hexachlorobenzene	µg/L	0.1	<0.1	
	Hexachloropropylene	µg/L	2	<2	Methoxychlor	µg/L	0.1	<0.1	
	Hexachlorobutadiene	µg/L	2	<2	Toxophene	µg/L	0.5	<2	
	Hexachlorocyclopentadiene	µg/L	10	<10	Dibutylchlorendate (surr.)	%	1	110	
	Pentachlorobenzene	µg/L	2	<2	Dibromo-DDE (surr.)	%	0.1	120	
	Hexachlorobenzene (HCB)	µg/L	4	<4	Phenolic Compounds	Phenol	µg/L	1	*400
	Dichlorodifluoromethane	µg/L	50	<50		2-Chlorophenol	µg/L	1	<2
	Chloromethane	µg/L	50	<50		2-Methylphenol	µg/L	1	<2
	Vinyl chloride	µg/L	50	<50		3- & 4-Methylphenol	µg/L	2	<2
Bromomethane	µg/L	50	<50	2-Nitrophenol		µg/L	5	<5	
Chloroethane	µg/L	50	<50	2.4-Dimethylphenol		µg/L	1	<2	
Trichlorofluoromethane	µg/L	50	<50	2.4-Dichlorophenol		µg/L	1	<2	
1.1-Dichloroethene	µg/L	5	<5	2.6-Dichlorophenol		µg/L	1	<2	
Iodomethane	µg/L	5	<5						

	trans-1,2-Dichloroethene	µg/L	5	<5		4-Chloro-3-Methylphenol	µg/L	1	<2	
	1,1-Dichloroethane	µg/L	5	<5		2,4,6-Trichlorophenol	µg/L	1	<2	
	cis-1,2-Dichloroethene	µg/L	5	<5		2,4,5-Trichlorophenol	µg/L	2	<2	
	1,1,1-Trichloroethane	µg/L	5	<5		Pentachlorophenol	µg/L	5	*22	
	1,1-Dichloropropylene	µg/L	5	<5		Phenol-d6 (surr.)	%	1	120	
	Carbon Tetrachloride	µg/L	5	<5		Naphthalene	µg/L	2	*70	
	1,2-Dichloroethane	µg/L	5	<5		2-Methylnaphthalene	µg/L	2	<2	
	Trichloroethene	µg/L	5	<5		2-Chloronaphthalene	µg/L	2	<2	
	Dibromomethane	µg/L	5	<5		Acenaphthylene	µg/L	2	<2	
	1,1,2-Trichloroethane	µg/L	5	*1900		Acenaphthene	µg/L	2	<2	
	1,3-Dichloropropane	µg/L	5	<5		Fluorene	µg/L	2	<2	
	Tetrachloroethene	µg/L	5	<5		Phenanthrene	µg/L	2	<2	
	1,1,1,2-Tetrachloroethane	µg/L	5	<5		Anthracene	µg/L	2	<2	
	trans-1,4-Dichloro-2-butene	µg/L	5	<5		Fluoranthene	µg/L	2	<2	
	cis-1,4-Dichloro-2-butene	µg/L	5	<5		Pyrene	µg/L	2	<2	
	1,1,2,2-Tetrachloroethane	µg/L	5	<5		N-2-Fluorenyl Acetamide	µg/L	2	<2	
	1,2,3-Trichloropropane	µg/L	5	<5		Benz(a)anthracene	µg/L	2	<2	
	Pentachloroethane	µg/L	5	<5		Chrysene	µg/L	2	<2	
	1,2-Dibromo-3-chloropropane	µg/L	5	<5		Benzo(b) & Benzo(k)fluoranthene	µg/L	4	<4	
	Hexachlorobutadiene	µg/L	5	<5		7,12-Dimethylbenz(a)anthracene	µg/L	2	<2	
	Nitroaromatics and Ketones	2-Picoline	µg/L	2		<2	Polynuclear Aromatic Hydrocarbons	Benzo(a)pyrene	µg/L	2
Acetophenone		µg/L	2	<2	3-Methylcholanthrene	µg/L		2	<2	
Nitrobenzene		µg/L	2	<2	Indeno(1,2,3.cd)pyrene	µg/L		2	<2	
Isophorone		µg/L	2	<2	Dibenz(a,h)anthracene	µg/L		2	<2	
2,6-Dinitrotoluene		µg/L	4	<4	Benzo(g,h,i)perylene	µg/L		2	<2	
2,4-Dinitrotoluene		µg/L	4	<4	Phthalate Esters	Dimethyl phthalate		µg/L	2	<2
1-Naphthylamine		µg/L	2	<2		Diethyl phthalate		µg/L	2	<2

	4-Nitroquinoline-N-oxide	µg/L	2	<2		Di-n-butyl phthalate	µg/L	2	<2	
	5-Nitro-o-toluidine	µg/L	2	<2		Butyl benzyl phthalate	µg/L	2	<2	
	Azobenzene	µg/L	2	<2		bis(2-ethylhexyl) phthalate	µg/L	20	<20	
	1.3.5-Trinitrobenzene	µg/L	2	<2		Di-n-octylphthalate	µg/L	2	<2	
	Phenacetin	µg/L	2	<2	Triazines	Ametryn	µg/L	1	<5	
	4-Aminobiphenyl	µg/L	2	<2		Atraton	µg/L	10	<5	
	Pentachloronitrobenzene	µg/L	2	<2		Atrazine	µg/L	1	<5	
	Pronamide	µg/L	2	<2		Prometon	µg/L	1	<5	
	Dimethylaminoazobenzene	µg/L	2	<2		Prometryn	µg/L	1	<5	
	Chlorobenzilate	µg/L	2	<2		Propazine	µg/L	1	<5	
Base/Neutral Extractable Surrogates	Nitrobenzene-D5	%	0.1	97.8		Simazine	µg/L	1	<5	
	1.2-Dichlorobenzene-D4	%	0.1	81.9		Simetryn	µg/L	1	<5	
	2-Fluorobiphenyl	%	0.1	104		Terbutylazine	µg/L	1	<5	
	Anthracene-d10	%	0.1	95.4		Terbutyrne	µg/L	1	<5	
	4-Terphenyl-d14	%	0.1	116	Total PCBs	µg/L	1	<1		
Haloethers	Bis(2-chloroethyl) ether	µg/L	2	<2	PCB	Decachlorobiphenyl (surr.)	%	0.1	109	
	Bis(2-chloroethoxy) methane	µg/L	2	<2	Oxygenated Compounds	Vinyl Acetate	µg/L	50	<50	
	4-Chlorophenyl phenyl ether	µg/L	2	<2		2-Butanone (MEK)	µg/L	50	<50	
	4-Bromophenyl phenyl ether	µg/L	2	<2		4-Methyl-2-pentanone (MIBK)	µg/L	50	<50	
						2-Hexanone (MBK)	µg/L	50	<50	
Acid Extractable Surrogates	2-Fluorophenol	%	0.1	61.6	Trihalo-methanes	Chloroform	µg/L	5	<5	
	Phenol-d6	%	0.1	49.5		Bromodichloromethane	µg/L	5	<5	
	2-Chlorophenol-D4	%	0.1	80.6		Dibromochloromethane	µg/L	5	<5	
	2.4.6-Tribromophenol	%	0.1	81.6		Bromoform	µg/L	5	<5	
Nitrogen & Phosphorus	Nitrite plus Nitrate as N (NOx)	mg/L	0.01	<0.010	VOC surr.	1.2-Dichloroethane-D4	%	0.1	127	
	Total Kjeldahl Nitrogen (TKN)	mg/L	0.1	<0.1						
	Total Nitrogen as N (TKN + NOx)	mg/L	0.1	<0.1			Toluene-D8	%	0.1	116

	Total Phosphorus as P	mg/L	0.05	0.07		4-Bromofluorobenzene	%	0.1	116
Fatty Acids	C10:0	µg / vial	-	0.03	Resin Acids	Resin Acid 1	µg / vial	-	-
	C12:0	µg / vial	-	0.01		Resin Acid 2	µg / vial	-	-
	C14:0	µg / vial	-	0.22		Pimaric	µg / vial	-	-
	C16:0	µg / vial	-	1.95		sandopimaric	µg / vial	-	-
	C18:0	µg / vial	-	1.17		isopimaric	µg / vial	-	-
	C18:1	µg / vial	-	0.3		dehydroabietic methyl ester	µg / vial	-	-
	C18:2	µg / vial	-	-		Palustric	µg / vial	-	-
	C20:0	µg / vial	-	0.03		Levopimaric	µg / vial	-	-
	C22:0	µg / vial	-	0.12		Resin acid 3	µg / vial	-	-
	C24:0	µg / vial	-	0.02		Resin acid 4	µg / vial	-	-
Chlorophenolics	4-chlorophenol	µg / vial	-	-	Sterols	Dehydroabietic (* corrected for blank)	µg / vial	-	0.06
	2,4,6-trichloroanisole	µg / vial	-	-		Abietic	µg / vial	-	-
	2,4-dichlorophenol	µg / vial	-	-		Resin acid 5	µg / vial	-	-
	2,4,6-trichlorophenol	µg / vial	-	-		Cholesterol	µg / vial	-	0.29
	4,5-dichloroveratrole	µg / vial	-	-		Campesterol	µg / vial	-	-
	4,5-dichloroguaiacol	µg / vial	-	-	Terpenes	Stigmasterol	µg / vial	-	-
	3,4,5-trichloroveratrole	µg / vial	-	-		b-sitosterol	µg / vial	-	-
	4,5-dichlorocatechol	µg / vial	-	-		α-pinene	µg / vial	-	-
	3,4,5-trichloroguaiacol	µg / vial	-	-		camphene	µg / vial	-	-
	2,3,4,6-tetrachlorophenol	µg / vial	-	-		β-pinene	µg / vial	-	-
	3,4,6-trichlorocatechol	µg / vial	-	-		α-terpinene	µg / vial	-	-
	4,5,6-trichloroguaiacol	µg / vial	-	-		limonene	µg / vial	-	-
	trichlorosyringol	µg / vial	-	-		cineole	µg / vial	-	-
	2-chlorosyringaldehyde	µg / vial	-	-		fenchone	µg / vial	-	-
	tetrachloroguaiacol	µg / vial	-	-		camphor	µg / vial	-	-
	pentachlorophenol	µg / vial	-	-		isoborneol	µg / vial	-	-

	2,6-dichlorosyringaldehyde	µg / vial	-	-		borneol	µg / vial	-	-
	tetrachlorocatechol	µg / vial	-	-		α-terpineol	µg / vial	-	-

* Provided by ANZECC

Sediment Quality Monitoring

Stage 1

It is proposed that sediment samples shall be collected at the same locations as the water samples detailed under Water Quality Monitoring Section which equates to 4 bottom samples per season or 16 samples per year analysed for analytes detailed in Table 9. Refer Stages 2 to 6 of this section for further explanation. Again a specialist consultant with documented sampling procedures shall be responsible for sample collection while NATA accredited laboratories shall undertake the analyses.

Stages 2 & 3

Critical assessment of the data recorded during baseline and pre operation monitoring will identify background sediment quality at the outfall site. Background data from these monitoring programs and further consultation with DTAE will ensure that target parameter selection (stage 3), sampling design (stage 4), approval process (stage 5) and program implementation (stage 6) are correctly developed and undertaken.

Target parameters will be selected for the operational monitoring program through consultation with DTAE.

Stages 4 & 5

The design and development of the sediment quality monitoring program will replicate principles of sample design, statistical methods and sample location discussed in the receiving waters monitoring program.

As per the receiving waters monitoring component, consultation with DTAE throughout the design stage process will be of high priority.

Stage 6

Sediment samples will be collected during baseline and pre operation monitoring. It is envisaged that any contamination of marine sediments at the study site are likely to be found within the surface layers, therefore sediment samples to a depth 0.5 m will be sufficient. Analysis of Stage 6 data will be undertaken as described in the Water Quality Monitoring Section.

Table 9: Effluent Outfall Monitoring Program- Sediment

Analyte	Units	Detection Limit	Interim Sediment Quality Guideline High	Analyte	Units	Detection Limit	Interim Sediment Quality Guideline High		
Sample Date				Sample Date					
Arsenic and Heavy Metals	Silver	mg/kg	-	*3.7	Fumigants	2.2-Dichloropropane	mg/kg	0.5	<0.5
	Arsenic	mg/kg	5	*70		1.2-Dichloropropane	mg/kg	0.5	<0.5
	Selenium	mg/kg	-	<1		cis-1.3-Dichloropropylene	mg/kg	0.5	<0.5
	Thallium	mg/kg	-	<0.1		trans-1.3-Dichloropropylene	mg/kg	0.5	<0.5
	Barium	mg/kg	10	4		1.2-Dibromoethane (EDB)	mg/kg	0.5	<0.5
	Beryllium	mg/kg	1	0.1	Halogenated Aliphatic Compounds	Dichlorodifluoromethane	mg/kg	5	<5
	Cadmium	mg/kg	1	*10		Chloromethane	mg/kg	5	<5
	Cobalt	mg/kg	2	4		Vinyl chloride	mg/kg	5	<5
	Bismuth	mg/kg	-	<0.1		Bromomethane	mg/kg	5	<5
	Chromium	mg/kg	2	*370		Chloroethane	mg/kg	5	<5
	Thorium	mg/kg	-	1.3		Trichlorofluoromethane	mg/kg	5	<5
	Copper	mg/kg	5	*270		1.1-Dichloroethene	mg/kg	0.5	<0.5
	Manganese	mg/kg	5	152		Iodomethane	mg/kg	0.5	<0.5
	Molybdenum	mg/kg	-	0.1		trans-1.2-Dichloroethene	mg/kg	0.5	<0.5
	Nickel	mg/kg	2	*52		1.1-Dichloroethane	mg/kg	0.5	<0.5
	Lead	mg/kg	5	*220		cis-1.2-Dichloroethene	mg/kg	0.5	<0.5
	Antimony	mg/kg	-	*25		1.1.1-Trichloroethane	mg/kg	0.5	<0.5
	Uranium	mg/kg	-	0.6		1.1-Dichloropropylene	mg/kg	0.5	<0.5

	Zinc	mg/kg	5	*410		Carbon Tetrachloride	mg/kg	0.5	<0.5
	Lithium	mg/kg	-	5.1		1.2-Dichloroethane	mg/kg	0.5	<0.5
	Vanadium	mg/kg	5	35		Trichloroethene	mg/kg	0.5	<0.5
	Tin	mg/kg	-	<0.1		Dibromomethane	mg/kg	0.5	<0.5
	Strontium	mg/kg	-	1280		1.1.2-Trichloroethane	mg/kg	0.5	<0.5
	Tellurium	mg/kg	-	<0.5		1.3-Dichloropropane	mg/kg	0.5	<0.5
	Titanium	mg/kg	-	175		Tetrachloroethene	mg/kg	0.5	<0.5
	Mercury	mg/kg	0.1	*1		1.1.1.2-Tetrachloroethane	mg/kg	0.5	<0.5
	Aluminium	mg/kg	50	2440		trans-1.4-Dichloro-2-butene	mg/kg	0.5	<0.5
	Boron	mg/kg	50	<50		cis-1.4-Dichloro-2-butene	mg/kg	0.5	<0.5
	Iron	mg/kg	50	8190		1.1.2.2-Tetrachloroethane	mg/kg	0.5	<0.5
EOX, AOX & Chlorate	EOX (wet weight)	mg.Cl/k g	-	0.086		1.2.3-Trichloropropane	mg/kg	0.5	<0.5
	EOX (dry weight)	mg.Cl/k g	-	0.124		Pentachloroethane	mg/kg	0.5	<0.5
	EOX (volatile)	mg.Cl/k g	-	4.472		1.2-Dibromo-3-chloropropane	mg/kg	0.5	<0.5
	Water Leachable AOX	mg/kg	-	0.15		Hexachlorobutadiene	mg/kg	0.5	<0.5
	Chlorate	mg/kg	0.5	<0.5		Bromochloromethane	mg/kg	0.5	<0.5
Monocyclic Aromatic Hydrocarbons	Benzene	mg/kg	0.5	<0.5	Halogenated Aromatic Compounds	Chlorobenzene	mg/kg	0.5	<0.5
	Toluene	mg/kg	0.5	<0.5		Bromobenzene	mg/kg	0.5	<0.5
	Ethylbenzene	mg/kg	0.5	<0.5		2-Chlorotoluene	mg/kg	0.5	<0.5
	meta- & para-Xylene	mg/kg	0.5	<0.5		4-Chlorotoluene	mg/kg	0.5	<0.5
	Styrene	mg/kg	0.5	<0.5		1.3-Dichlorobenzene	mg/kg	0.5	<0.5
	ortho-Xylene	mg/kg	0.5	<0.5		1.4-Dichlorobenzene	mg/kg	0.5	<0.5
	Isopropylbenzene	mg/kg	0.5	<0.5		1.2-Dichlorobenzene	mg/kg	0.5	<0.5
	n-Propylbenzene	mg/kg	0.5	<0.5		1.2.4-Trichlorobenzene	mg/kg	0.5	<0.5
	1.3.5-Trimethylbenzene	mg/kg	0.5	<0.5		1.2.3-Trichlorobenzene	mg/kg	0.5	<0.5

	sec-Butylbenzene	mg/kg	0.5	<0.5		Chloroform	mg/kg	0.5	<0.5
	1.2.4-Trimethylbenzene	mg/kg	0.5	<0.5	Trihalomethanes	Bromodichloromethane	mg/kg	0.5	<0.5
	tert-Butylbenzene	mg/kg	0.5	<0.5		Dibromochloromethane	mg/kg	0.5	<0.5
	p-Isopropyltoluene	mg/kg	0.5	<0.5		Bromoform	mg/kg	0.5	<0.5
	n-Butylbenzene	mg/kg	0.5	<0.5					
	Vinyl Acetate	mg/kg	5	<5		Base/Neutral Extractable Surrogates	Nitrobenzene-D5	%	0.1
Oxygenated Compounds	2-Butanone (MEK)	mg/kg	5	<5	1.2-Dichlorobenzene-D4		%	0.1	74.6
	4-Methyl-2-pentanone (MIBK)	mg/kg	5	<5	2-Fluorobiphenyl		%	0.1	91.7
	2-Hexanone (MBK)	mg/kg	5	<5	Anthracene-d10		%	0.1	84.9
					4-Terphenyl-d14	%	0.1	100	
Acid Extractable Surrogates	2-Fluorophenol	%	0.1	89.8	VOC Surrogates	1.2-Dichloroethane-D4	%	0.1	102
	Phenol-d6	%	0.1	96.8		Toluene-D8	%	0.1	109
	2-Chlorophenol-D4	%	0.1	96.1		4-Bromofluorobenzene	%	0.1	99
	2.4.6-Tribromophenol	%	0.1	54.8					
Dioxins - Individual	2378-TCDD	pg/g	0.25	0.7	Polynuclear Aromatic Hydrocarbons	Naphthalene	mg/kg	0.5	*2100
	12378-PeCDD	pg/g	1.25	<2.5		2-Methylnaphthalene	mg/kg	0.5	<0.5
	123478-HxCDD	pg/g	1.25	<2.5		2-Chloronaphthalene	mg/kg	0.5	<0.5
	123678-HxCDD	pg/g	1.25	<2.5		Acenaphthylene	mg/kg	0.5	*640
	123789-HxCDD	pg/g	1.25	<2.5		Acenaphthene	mg/kg	0.5	*500
	1234678-HpCDD	pg/g	1.25	5.2		Fluorene	mg/kg	0.5	*540
	OCDD	pg/g	5	53		Phenanthrene	mg/kg	0.5	*1500
	2378-TCDF	pg/g	0.25	<0.5		Anthracene	mg/kg	0.5	*1100
	12378-PeCDF	pg/g	1.25	<2.5		Fluoranthene	mg/kg	0.5	*5100
	23478-PeCDF	pg/g	1.25	<2.5		Pyrene	mg/kg	0.5	*2600
	123478-HxCDF	pg/g	1.25	<2.5		N-2-Fluorenyl Acetamide	mg/kg	0.5	<0.5
	123678-HxCDF	pg/g	1.25	<2.5		Benz(a)anthracene	mg/kg	0.5	*1600
	234678-HxCDF	pg/g	1.25	<2.5		Chrysene	mg/kg	0.5	*2800
	123789-HxCDF	pg/g	1.25	<2.5		Benzo(b) & Benzo(k)fluoranthene	mg/kg	1	<1

	1234678-HpCDF	pg/g	1.25	<2.5		7.12-Dimethylbenz(a)anthracene	mg/kg	0.5	<0.5
	1234789-HpCDF	pg/g	1.25	<2.5		Benzo(a)pyrene	mg/kg	0.5	*1600
	OCDF	pg/g	2.5	<5.0		3-Methylcholanthrene	mg/kg	0.5	<0.5
	2378-TCDD (13C12)	pg/g	0.25	67.7		Indeno(1.2.3.cd)pyrene	mg/kg	0.5	<0.5
	12378-PeCDD (13C12)	pg/g	0.25	74.2		Dibenz(a.h)anthracene	mg/kg	0.5	*260
	123478-HxCDD (13C12)	pg/g	0.25	82.6		Benzo(g.h.i)perylene	mg/kg	0.5	<0.5
	123678-HxCDD (13C12)	pg/g	0.25	88.8		Dimethyl phthalate	mg/kg	0.5	<0.5
	1234678-HpCDD (13C12)	pg/g	0.25	79.9	Phthalate Esters	Diethyl phthalate	mg/kg	0.5	<0.5
	OCDD (13C12)	pg/g	0.25	64.2		Di-n-butyl phthalate	mg/kg	0.5	<0.5
	2378-TCDF (13C12)	pg/g	0.25	65.3		Butyl benzyl phthalate	mg/kg	0.5	<0.5
	12378-PeCDF (13C12)	pg/g	0.25	84.3		bis(2-ethylhexyl) phthalate	mg/kg	5	<0.5
	23478-PeCDF (13C12)	pg/g	0.25	85.2		Di-n-octylphthalate	mg/kg	0.5	<0.5
	123478-HxCDF (13C12)	pg/g	0.25	82.3					
	123678-HxCDF (13C12)	pg/g	0.25	86.8	Nitrosamines	N-Nitrosomethylethylamine	mg/kg	0.5	<0.5
	234678-HxCDF (13C12)	pg/g	0.25	90.8		N-Nitrosodiethylamine	mg/kg	0.5	<0.5
	123789-HxCDF (13C12)	pg/g	0.25	83.8		N-Nitrosopyrrolidine	mg/kg	1	<1.0
	1234678-HpCDF (13C12)	pg/g	0.25	98.6		N-Nitrosomorpholine	mg/kg	0.5	<0.5
	1234789-HpCDF (13C12)	pg/g	0.25	100		N-Nitrosodi-n-propylamine	mg/kg	0.5	<0.5
Dioxins and Furans	Tetra-dioxins	pg/g	0.5-0.6	1.2		N-Nitrosopiperidine	mg/kg	0.5	<0.5
	Penta-dioxins	pg/g	2.4-3.2	<4.9		N-Nitrosodibutylamine	mg/kg	0.5	<0.5
	Hexa-dioxins	pg/g	2.4-3.2	10.9		N-Nitrosodiphenyl & Diphenylamine	mg/kg	1	<1.0
	Hepta-dioxins	pg/g	2.4-3.2	23.9		Methapyrilene	mg/kg	0.5	<0.5
	Octa-dioxin	pg/g	9.7-12.9	53		Nitroaromatics and Ketones	2-Picoline	mg/kg	0.5
	Tetra-furans	pg/g	0.5-0.6	5.2	Acetophenone		mg/kg	0.5	<0.5
	Penta-furans	pg/g	2.4-3.2	<14.7	Nitrobenzene		mg/kg	0.5	<0.5
	Hexa-furans	pg/g	2.4-3.2	<14.7	Isophorone		mg/kg	0.5	<0.5
					2.6-Dinitrotoluene	mg/kg	1	<1.0	

	Hepta-furans	pg/g	2.4-3.2	<9.8		2.4-Dinitrotoluene	mg/kg	1	<1.0
	Octa-furan	pg/g	4.9-6.5	<6.5		1-Naphthylamine	mg/kg	0.5	<0.5
	Σ PCDD/Fs	pg/g	-	143		4-Nitroquinoline-N-oxide	mg/kg	0.5	<0.5
Phenolic Compounds	Phenol	mg/kg	0.5	<0.5	Chlorinated Hydrocarbons	5-Nitro-o-toluidine	mg/kg	0.5	<0.5
	2-Chlorophenol	mg/kg	0.5	<0.5		Azobenzene	mg/kg	1	<1
	2-Methylphenol	mg/kg	0.5	<0.5		1.3.5-Trinitrobenzene	mg/kg	0.5	<0.5
	3- & 4-Methylphenol	mg/kg	0.5	<0.5		Phenacetin	mg/kg	0.5	<0.5
	2-Nitrophenol	mg/kg	0.5	<0.5		4-Aminobiphenyl	mg/kg	0.5	<0.5
	2.4-Dimethylphenol	mg/kg	0.5	<0.5		Pentachloronitrobenzene	mg/kg	0.5	<0.5
	2.4-Dichlorophenol	mg/kg	0.5	<0.5		Pronamide	mg/kg	0.5	<0.5
	2.6-Dichlorophenol	mg/kg	0.5	<0.5		Dimethylaminoazobenzene	mg/kg	0.5	<0.5
	4-Chloro-3-Methylphenol	mg/kg	0.5	<0.5		Chlorobenzilate	mg/kg	0.5	<0.5
	2.4.6-Trichlorophenol	mg/kg	0.5	<0.5		1.3-Dichlorobenzene	mg/kg	0.5	<0.5
	2.4.5-Trichlorophenol	mg/kg	0.5	<0.5		1.4-Dichlorobenzene	mg/kg	0.5	<0.5
	Pentachlorophenol	mg/kg	5	<0.5		1.2-Dichlorobenzene	mg/kg	0.5	<0.5
	Phenol-d6 (surr.)	%	-	82		Hexachloroethane	mg/kg	0.5	<0.5
Haloethers	Bis(2-chloroethyl) ether	mg/kg	0.5	<0.5	1.2.4-Trichlorobenzene	mg/kg	0.5	<0.5	
	Bis(2-chloroethoxy) methane	mg/kg	0.5	<0.5	Hexachloropropylene	mg/kg	0.5	<0.5	
	4-Chlorophenyl phenyl ether	mg/kg	0.5	<0.5	Hexachlorobutadiene	mg/kg	0.5	<0.5	
	4-Bromophenyl phenyl ether	mg/kg	0.5	<0.5	Hexachlorocyclopentadiene	mg/kg	2.5	<2.5	
Anilines and Benzidines	Aniline	mg/kg	0.5	<0.5	Pentachlorobenzene	mg/kg	0.5	<0.5	
	4-Chloroaniline	mg/kg	0.5	<0.5	Hexachlorobenzene (HCB)	mg/kg	1	<1.0	
	2-Nitroaniline	mg/kg	1	<1.0	2.4-D	mg/kg	0.5	<0.5	
	3-Nitroaniline	mg/kg	1	<1.0	2.4-DB	mg/kg	0.5	<0.5	
					2.4.5-T	mg/kg	0.5	<0.5	
				2.4.5-TP	mg/kg	0.5	<0.5		

	Dibenzofuran	mg/kg	0.5	<0.5		Actril (loxynil)	mg/kg	0.5	<0.5	
	4-Nitroaniline	mg/kg	0.5	<0.5		Dicamba	mg/kg	0.5	<0.5	
	Carbazole	mg/kg	0.5	<0.5		Dichlorprop	mg/kg	0.5	<0.5	
	3,3'-Dichlorobenzidine	mg/kg	0.5	<0.5		Dinitro-o-cresol	mg/kg	0.5	<0.5	
Miscellaneous Compounds	Naphthalene	mg/kg	5	<5	Triazines	Dinoseb	mg/kg	0.5	<0.5	
	Carbon disulfide	mg/kg	0.5	<0.5		MCPA	mg/kg	0.5	<0.5	
	1,3,5-Trichlorobenzene	mg/kg	0.5	<0.5		MCPB	mg/kg	0.5	<0.5	
	1,2,4,5-Tetrachlorobenzene	mg/kg	0.5	<0.5		Mecoprop	mg/kg	0.5	<0.5	
	Methanesulfonate methyl	mg/kg	0.5	<0.5		Warfarin (surr.)	%	-	110	
	Methanesulfonate ethyl	mg/kg	0.5	<0.5		Ametryn	mg/kg	0.2	<0.2	
	cis-Isosafrole	mg/kg	0.5	<0.5		Atraton	mg/kg	0.2	<0.2	
	trans-Isosafrole	mg/kg	0.5	<0.5		Atrazine	mg/kg	0.2	<0.2	
	Safrole	mg/kg	0.5	<0.5		Prometon	mg/kg	0.2	<0.2	
	Diallate	mg/kg	0.5	<0.5		Prometryn	mg/kg	0.2	<0.2	
	2,3,4,6-Tetrachlorophenol	mg/kg	0.5	<0.5		Propazine	mg/kg	0.2	<0.2	
	Organochlorine Pesticides	4,4'-DDD	mg/kg	0.05		*20	PCB	Simazine	mg/kg	0.2
4,4'-DDE		mg/kg	0.05	*27	Simetryn	mg/kg		0.2	<0.2	
4,4'-DDT		mg/kg	0.05	*46	Terbutylazine	mg/kg		0.2	<0.2	
a-BHC		mg/kg	0.05	<0.05	Terbutyrne	mg/kg		0.2	<0.2	
Aldrin		mg/kg	0.05	<0.05	Total PCBs	mg/kg		0.1	23	
b-BHC		mg/kg	0.05	<0.05	Decachlorobiphenyl (surr.)	%		0.1	103	
Chlordane		mg/kg	0.01	*6	Organophosphorous Pesticides	Bolstar		mg/kg	0.2	<0.2
d-BHC		mg/kg	0.05	<0.05		Chlorpyrifos		mg/kg	0.2	<0.2
Dieldrin		mg/kg	0.05	*8		Coumaphos		mg/kg	0.2	<0.2
Endosulfan I		mg/kg	0.05	<0.05		Demeton-O		mg/kg	0.2	<0.2
Endosulfan II		mg/kg	0.05	<0.05		Diazinon		mg/kg	0.2	<0.2
Endosulfan sulphate		mg/kg	0.05	<0.05		Dichlorvos		mg/kg	0.2	<0.2

	Endrin	mg/kg	0.05	*8		Disulfoton	mg/kg	0.2	<0.2
	Endrin aldehyde	mg/kg	0.05	<0.05		Ethion	mg/kg	0.2	<0.2
	Endrin ketone	mg/kg	0.05	<0.05		Ethoprop	mg/kg	0.2	<0.2
	g-BHC (Lindane)	mg/kg	0.05	*1		Fenitrothion	mg/kg	0.2	<0.2
	Heptachlor	mg/kg	0.05	<0.05		Fensulfothion	mg/kg	0.2	<0.2
	Heptachlor epoxide	mg/kg	0.05	<0.05		Fenthion	mg/kg	0.2	<0.2
	Hexachlorobenzene	mg/kg	0.05	<0.05		Merphos	mg/kg	0.2	<0.2
	Methoxychlor	mg/kg	0.05	<0.05		Methyl azinphos	mg/kg	0.2	<0.2
	Toxophene	mg/kg	0.01	<0.1		Methyl parathion	mg/kg	0.2	<0.2
	Dibutylchlorendate (surr.)	%	-	140		Mevinphos	mg/kg	0.2	<0.2
Fatty Acids	C10:0	µg / vial		0.04	Chlorophenolics	Naled	mg/kg	0.2	<0.2
	C12:0	µg / vial		0.07		Phorate	mg/kg	0.2	<0.2
	C14:0	µg / vial		0.62		Ronnel	mg/kg	0.2	<0.2
	C16:0	µg / vial		3.07		Tokuthion	mg/kg	0.2	<0.2
	C18:0	µg / vial		2.55		Trichloronate	mg/kg	0.2	<0.2
	C18:1	µg / vial		1.35		Triphenylphosphate (surr.)	%	-	120
	C18:2	µg / vial		0		4-chlorophenol	µg / vial		0
	C20:0	µg / vial		0.44		2,4,6-trichloroanisole	µg / vial		0
	C22:0	µg / vial		0.1		2,4-dichlorophenol	µg / vial		0
	C24:0	µg / vial		0		2,4,6-trichlorophenol	µg / vial		0
Resin Acids	Resin Acid 1	µg / vial		0	4,5-dichloroveratrole	µg / vial		0	
	Resin Acid 2	µg / vial		0	4,5-dichloroguaiacol	µg / vial		0	
	Pimaric	µg / vial		0	3,4,5-trichloroveratrole	µg / vial		0	
	sandopimaric	µg / vial		0	4,5-dichlorocatechol	µg / vial		0	
	isopimaric	µg / vial		0	3,4,5-trichloroguaiacol	µg / vial		0	
	dehydroabiatic methyl ester	µg / vial		0	2,3,4,6-tetrachlorophenol	µg / vial		0	
	Palustric	µg / vial		0.02	3,4,6-trichlorocatechol	µg / vial		0	

	Levopimaric	µg / vial	0.05		4,5,6-trichloroguaiacol	µg / vial	0
	Resin acid 3	µg / vial	0		trichlorosyringol	µg / vial	0
	Resin acid 4	µg / vial	0		2-chlorosyringaldehyde	µg / vial	0
	Dehydroabietic (* corrected for blank)	µg / vial	0.92		tetrachloroguaiacol	µg / vial	0
	Abietic	µg / vial	0.77		pentachlorophenol	µg / vial	0
	Resin acid 5	µg / vial	0		2,6-dichlorosyringaldehyde	µg / vial	0
Sterols	Cholesterol	µg / vial	1.52	Terpenes	tetrachlorocatechol	µg / vial	0
	Campesterol	µg / vial	0.05		α-pinene	µg / vial	0
	Stigmasterol	µg / vial	0.22		camphene	µg / vial	0
	β-sitosterol	µg / vial	0.21		β-pinene	µg / vial	0
					α-terpinene	µg / vial	0
					limonene	µg / vial	0
					cineole	µg / vial	0
					fenchone	µg / vial	0
					camphor	µg / vial	0
					isoborneol	µg / vial	0
					borneol	µg / vial	0
					α-terpineol	µg / vial	0

* Provided by ANZECC

Bioassay and Morphological Assessment of Biota

Stage 1

It is proposed that bioassay samples shall be collected at the same locations as the water samples detailed in the Water Quality Monitoring Section. The number of species and individuals will be determined jointly with DPIW and DTAE. They will be tested for analytes detailed in Table 10. Refer to Stages 2 to 6 of this section for further explanation. A specialist consultant with documented sampling procedures shall be responsible for sample collection while NATA accredited laboratories shall undertake the analyses.

Stages 2 & 3

Critical assessment of the data recorded during baseline and pre operation monitoring will identify background bioassay data at the outfall site. Background data from these monitoring programs and further consultation with DTAE will ensure that target parameter selection (stage 3), sampling design (stage 4), approval process (stage 5) and program implementation (stage 6) are correctly developed and undertaken.

Target parameters will be selected for the operational monitoring program through consultation with DTAE.

Stages 4 & 5

The proposed receiving waters monitoring program will be designed in compliance with requirements for the following documents as specified in the RPDC IIS Final Scope Guidelines:

- ▶ Protocols for designing marine ecological monitoring programs associated with BEK mills.

The design and development of the bioassay and morphological assessment monitoring program will replicate principles of sample design, statistical methods and sample location discussed in the receiving waters monitoring program.

Specific requirements associated with this component relate to the selection of target species. These will be selected in accordance with requirements as outlined in Table 9 and Section D.4.13 of the RPDC IIS Final Scope Guidelines. Selection of suitable biota for bioassay requires consideration of life history traits including: longevity, territorial and seasonal / migratory behaviour, recruitment strategies, and local abundance. Ease of capture and popularity for human consumption will also be considered in determining the optimum target species.

Note that probability of obtaining preferred target species on a routine basis for bioassay is highly variable and dependent upon a multitude of environmental and behavioural parameters. Subsequently, the statistical rigour of bioassay monitoring programs is often compromised due to:

- ▶ Unequal number of samples collected at each site, which results in an unbalanced design and has associated implications for statistical analysis; and
- ▶ The inability to collect the same species at all sample locations, therefore statistical comparison is compromised given underlying physiological differences associated with contaminant bioaccumulation.

This logistical problem can be simply overcome through the deployment of sedentary species (such as shellfish) in sea cages at each sampling location.

As per the receiving waters monitoring component, consultation with DTAE throughout the design stage process will be of high priority. The RPDC's requirements must also be incorporated into the monitoring program, specifically that:

- ▶ *Species to be studied and locations of sampling sites will be chosen based on a sound knowledge of the physical oceanography and distribution of marine biota within the possible zone of influence of the mill. Those will be provided by site suitability, sample site and species selection studies; and*
- ▶ *Species chosen should have life spans and behavioural patterns appropriate to detection of potential short-term sub lethal toxicity effects on populations. Individuals of the species should potentially be resident in the area of the sampling site for a considerable proportion of their adult life.*

Stage 6

Sampling methodology should remain consistent through pre-operation and operation monitoring. Samples should be collected using divers, or by the deployment of cages containing live species samples. All sampling will be undertaken using strict QA/QC protocol described in Section 0.

Table 10: Effluent Outfall Monitoring Program- Combined Algae, Biota and Fish

Analyte		Unit	Algae Detection Limit	Algae 95% Protection	Fish Detection Limit	Fish 95% Protection	Biota Detection Limit	Biota 95% Protection
Sample Date								
Fatty Acids	C10:0	µg / vial	-	1.42	-	0.61	-	-
	C12:0	µg / vial	-	2.74	-	1.27	-	-
	C14:0	µg / vial	-	55.68	-	45.41	-	-
	C16:0	µg / vial	-	106.42	-	120.5	-	-
	C18:0	µg / vial	-	44.96	-	43.89	-	-
	C18:1	µg / vial	-	95.97	-	108.82	-	-
	C18:2	µg / vial	-	1307.97	-	36.75	-	-
	C20:0	µg / vial	-	2.19	-	1.93	-	-
	C22:0	µg / vial	-	3.59	-	0.7	-	-
	C24:0	µg / vial	-	31.26	-	0.65	-	-
Resin Acids	Resin Acid 1	µg / vial	-	2.3	-	4.08	-	-
	Resin Acid 2	µg / vial	-	3.02	-	3.01	-	-
	Pimaric	µg / vial	-	7.93	-	6.71	-	-
	sandopimaric	µg / vial	-	1.66	-	1.09	-	-
	isopimaric	µg / vial	-	7.26	-	4.71	-	-
	dehydroabietic methyl ester	µg / vial	-	1.385	-	1.1	-	-
	Palustric	µg / vial	-	1.26	-	1.11	-	-
	Levopimaric	µg / vial	-		-	1.49	-	-
Resin acid 3	µg / vial	-	1.4	-	8.74	-	-	

	Resin acid 4	µg / vial	-	309	-	1	-	-
	Dehydroabietic (* corrected for blank)	µg / vial	-	15.76	-	14.69	-	-
	Abietic	µg / vial	-	45.02	-	2.25	-	-
	Resin acid 5	µg / vial	-	1.66	-	1.51	-	-
Sterols	Cholesterol	µg / vial	-	199.45	-	462.66	-	-
	Campesterol	µg / vial	-	2.42	-	0.18	-	-
	Stigmasterol	µg / vial	-	11.82	-	0	-	-
	b-sitosterol	µg / vial	-	40.88	-	0.49	-	-
Chlorophenolics	4-chlorophenol	µg / vial	-	-	-	-	-	-
	2,4,6-trichloroanisole	µg / vial	-	-	-	-	-	-
	2,4-dichlorophenol	µg / vial	-	-	-	-	-	-
	2,4,6-trichlorophenol	µg / vial	-	-	-	-	-	-
	4,5-dichloroveratrole	µg / vial	-	-	-	-	-	-
	4,5-dichloroguaiacol	µg / vial	-	-	-	-	-	-
	3,4,5-trichloroveratrole	µg / vial	-	-	-	-	-	-
	4,5-dichlorocatechol	µg / vial	-	-	-	-	-	-
	3,4,5-trichloroguaiacol	µg / vial	-	-	-	-	-	-
	2,3,4,6-tetrachlorophenol	µg / vial	-	-	-	-	-	-
	3,4,6-trichlorocatechol	µg / vial	-	-	-	-	-	-
	4,5,6-trichloroguaiacol	µg / vial	-	-	-	-	-	-
	trichlorosyringol	µg / vial	-	-	-	-	-	-
	2-chlorosyringaldehyde	µg / vial	-	-	-	-	-	-
	tetrachloroguaiacol	µg / vial	-	-	-	-	-	-
pentachlorophenol	µg / vial	-	-	-	0.04	-	-	
2,6-dichlorosyringaldehyde	µg / vial	-	-	-	-	-	-	
tetrachlorocatechol	µg / vial	-	-	-	-	-	-	
Terpenes	α-pinene	µg / vial	-	-	-	-	-	-

	camphene	µg / vial	-	-	-	-	-	-
	β-pinene	µg / vial	-	-	-	-	-	-
	α-terpinene	µg / vial	-	-	-	-	-	-
	limonene	µg / vial	-	-	-	-	-	-
	cineole	µg / vial	-	-	-	-	-	-
	fenchone	µg / vial	-	-	-	-	-	-
	camphor	µg / vial	-	-	-	-	-	-
	isoborneol	µg / vial	-	-	-	-	-	-
	borneol	µg / vial	-	-	-	-	-	-
	α-terpineol	µg / vial	-	-	-	-	-	-
Heavy Metals	Aluminium	mg/kg	-	-	-	-	50	355
	Antimony	mg/kg	-	-	-	-	5	<5
	Arsenic	mg/kg	-	-	-	-	5	10.8
	Barium	mg/kg	-	-	-	-	10	45.4
	Beryllium	mg/kg	-	-	-	-	1	<1
	Bismuth	mg/kg	-	-	-	-	0.1	0.1
	Boron	mg/kg	-	-	-	-	50	46.4
	Cadmium	mg/kg	-	-	-	-	1	0.2
	Chromium	mg/kg	-	-	-	-	2	1
	Cobalt	mg/kg	-	-	-	-	2	0.2
	Copper	mg/kg	-	-	-	-	5	5.1
	Iron	mg/kg	-	-	-	-	50	480
	Lead	mg/kg	-	-	-	-	5	0.8
	Lithium	mg/kg	-	-	-	-	0.1	0.6
	Manganese	mg/kg	-	-	-	-	5	24
Molybdenum	mg/kg	-	-	-	-	2	440	
Nickel	mg/kg	-	-	-	-	2	2.8	

	Selenium	mg/kg	-	-	-	-	5	<5
	Silver	mg/kg	-	-	-	-	2	0.2
	Strontium	mg/kg	-	-	-	-	2	256
	Tellurium	mg/kg	-	-	-	-	0.5	0.5
	Thallium	mg/kg	-	-	-	-	0.1	<0.1
	Thorium	mg/kg	-	-	-	-	0.1	1.3
	Tin	mg/kg	-	-	-	-	5	0.2
	Titanium	mg/kg	-	-	-	-	10	28
	Uranium	mg/kg	-	-	-	-	0.1	0.1
	Vanadium	mg/kg	-	-	-	-	5	37
	Zinc	mg/kg	-	-	-	-	5	20
	Mercury	mg/kg	-	-	-	-	0.1	0.6
	Calcium	mg/kg	-	-	-	-	50	47600
	Magnesium	mg/kg	-	-	-	-	50	910
	Sodium	mg/kg	-	-	-	-	50	1870
	Potassium	mg/kg	-	-	-	-	50	4770
	Sulphur as S	mg/kg	-	-	-	-	50	2700
	Phosphorus	mg/kg	-	-	-	-	50	24500
Trihalo- methanes	Chloroform	mg/kg	-	-	-	-	0.5	0.6
	Bromodichloromethane	mg/kg	-	-	-	-	0.5	<0.5
	Dibromochloromethane	mg/kg	-	-	-	-	0.5	<0.5
	Bromoform	mg/kg	-	-	-	-	0.5	17
Dioxins and Furans	Tetra-dioxins	pg/g	-	-	-	-	-	<3.7
	Penta-dioxins	pg/g	-	-	-	-	-	<16.7
	Hexa-dioxins	pg/g	-	-	-	-	-	<13
	Hepta-dioxins	pg/g	-	-	-	-	-	0.8
	Octa-dioxin	pg/g	-	-	-	-	-	178.4

	Tetra-furans	pg/g	-	-	-	-	-	16.9
	Penta-furans	pg/g	-	-	-	-	-	<14.1
	Hexa-furans	pg/g	-	-	-	-	-	<50.2
	Hepta-furans	pg/g	-	-	-	-	-	<33.4
	Octa-furan	pg/g	-	-	-	-	-	<16.1
	Σ PCDD/Fs	pg/g	-	-	-	-	-	178.4
EOX & Chlorate	EOX (wet weight)	mg.Cl/kg	-	-	-	-	0.03	733
	EOX (dry weight)	mg.Cl/kg	-	-	-	-	-	3963
	Chlorate	mg/kg	-	-	-	-	0.5	<0.5
VOC	1,2-Dichloroethane-D4 (surr.)	%	-	-	-	-	0.1	94
	Toluene-D8 (surr.)	%	-	-	-	-	0.1	101
	4-Bromofluorobenzene (surr.)	%	-	-	-	-	0.1	91.2

Tainting of Seafood

In addition to testing samples for target contaminants RPDC Emission Limit Guidelines stipulate that tainting of seafood tests are also required. The value and practical application of the seafood taint tests is yet to be established, and requires further consultation with a specialist in this field, and will be resolved prior to operation of the outfall.

Tainting of seafood tests is typically conducted utilising a taste panel test of the most sensitive edible and available biota. In the event that suitable samples and specimens of a consumable nature cannot be collected this requirement will require review for ongoing monitoring requirements within the OMP

Scallops, mussels and finfish may be sampled quarterly for both chemical and sensory analyses. The latter will be conducted only after the chemical results have been obtained to prove the wholesomeness of the samples.

Ecological Condition of Benthic Communities

Stage 1

Statistical analyses of the benthic infauna surveys conducted as part of the monitoring associated with the Draft IIS should be completed by end July 2006. This together with Stage 6 and advice from DPIW and DTAE will allow the development of a comprehensive ecological assessment program.

Specific requirements for assessment of ecological condition of benthic communities are detailed in Section D.4.13 of the RPDC IIS Final Scope Guidelines.

Stages 2 & 3

Stages 2 and 3 will be undertaken as described for water quality monitoring. However of note, is the availability of epi-benthic baseline data collected during recent completion of ecological studies undertaken by Aquenal, and CSIRO Marine Research (2000), for other pipeline infrastructure projects in the vicinity of the proposed pulp mill discharge site.

Stages 4 & 5

The operational monitoring program will be designed in compliance with requirements for the following documents as specified in the RPDC IIS Final Scope Guidelines:

- ▀ Protocols for designing marine ecological monitoring programs associated with BEK mills.

The design and development of the benthic ecological condition monitoring program will replicate principles of sample design, statistical methods and sample location discussed in the receiving waters monitoring program.

Control Sample stations for the operation monitoring need to be identical to pre operation control sites for statistical rigour and accurate data analysis. Note that control sample locations may vary to those selected for collection of samples for chemical analysis. This may occur due to the requirement of selecting operational control stations characterised by a similar suit of benthos to that recorded at proposed impact stations.

As per the receiving waters monitoring component, consultation with DTAE throughout the design stage process will be of high priority. Specifically that:

- ▶ *The comprehensive pre-operational study of the distribution, abundance and diversity of marine plants, animals and sediments, and of their seasonal and inter-annual change, will be used to establish pre-operational conditions in the probable zone of influence around the outfall.*

Stage 6

Specific requirements associated with implementing this monitoring program relate the method of data capture. Ecological condition assessment of benthic communities will be undertaken using a variety of methods including:

- ▶ Conduct digital video line intercept transects which capture footage of the sea bed;
- ▶ Deployment of baited video bounce cameras to assess fish assemblages; and
- ▶ Deployment of sediment grabs to capture benthic in-fauna samples.

The use of digital video to capture footage of line intercept transects was pioneered by the Australian Institute of Marine Science and is the preferred method of benthic ecological condition assessment for the Great Barrier Reef Marine Park Authority. This methodology is recommended to establish baseline data sets for all long-term ecological monitoring programs.

Statistical analysis for data recorded during the implementation process of this program will be consistent with those outlined under Stage 5 as described for Water Quality Monitoring. In addition the following deliverables will be produced as a result of implementing this program:

- ▶ Percentage cover *estimates* (relative community composition and abundance) for each key epibenthic habitat identified to occur at each survey location, such as: rocky reef, seagrass, sand, oyster communities, and macro-algae communities.
- ▶ Habitat maps delineating the pre-operational distribution of marine benthos in the vicinity of the proposed outfall site; and
- ▶ Benthic infauna inventory and analysis of species diversity, and abundance indices.

Field Sampling & Laboratory QA/QC

The QA/QC procedures, should be based on current Australian accepted standards comprising:

- ▶ AS/NZS 5667.1:1998 Water quality - Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.

Field Sampling QA/QC

Rigorous Quality Assurance and Quality Control (QA/QC) procedures will be implemented throughout all sampling activities undertaken on this project. Of primary importance will be the adoption of consistent and repeatable sampling techniques / methodologies and risk minimisation strategies throughout the entire sampling program. These procedures will include:

- ▶ Use of the appropriate sample storage containers and preservation techniques (use of laboratory-supplied storage containers, use of appropriate preservative reagents, storage of samples to the appropriate temperatures);
- ▶ Elimination of the risk associated with sample cross contamination and field contamination through use of stainless steel sampling instruments (sediment grabs), and implementation of decontamination procedures (triple rinses with seawater and phosphate free detergents) between each sampling event;
- ▶ Implementation and review of sample register documentation, which will include field conditions (weather, tides, currents), station locations, sampling methods and handling and storage methods, field numbers, date, time, sample identifiers and sample characteristics. Sample register documentation will be reviewed internally prior to demobilisation to the next sampling station;
- ▶ Implementation of appropriate sample documentation and preservation procedures during sample storage, dispatch, and transportation. This will include use of chain-of-custody (COC) documentation, which will accompany each sample throughout dispatch. COC documentation will specify sample identifiers, the required analyses and detection limits. Accompanying each sample batch will be temperature thermometers that will record minimum and maximum temperatures from the point of dispatch to the laboratory door. After receipt by the lab, the COC will be checked by the laboratory and returned to sender;
- ▶ Use of sample splits and sample duplicates (replicates) for QA/QC purposes is an integral component of the sampling program for each of the four survey locations. These will be taken at each site according to the specified scope of works (refer to sample design for each location); and
- ▶ Trip Blank samples with contaminant concentrations below detection limits will accompany samples over the course of the fieldwork and will be submitted to the primary laboratory for analyses. Trip blanks provide an indication of possible contamination introduced during sample transport and handling. Trip blanks will be analysed at an approximate rate of 1 per batch of 20 water samples submitted to the laboratory.

4.4.6 Landfill and Pulp Mill Soil, Surface Water and Leachate Monitoring

Landfill Monitoring

The monitoring of leachate, surface water and soil from the landfill site will consist of a 4-stage process, to ensure detailed analysis using statistical comparisons is achieved. This is summarised by;

- ▶ 2.5 year Pre Operational Monitoring Program;
- ▶ Data review of baseline and pre operation monitoring;
- ▶ Sampling design development- sampling locations, frequency and parameter identification; and
- ▶ Program implementation.

2.5 yr Pre-Operational Monitoring Program

It is proposed to collect water samples from the existing natural water course at point of entry and exit from the proposed landfill. Samples shall be collected mid each season to ascertain seasonal variation, if the stream is flowing or stagnant at time of collection it is to be noted. Soil samples shall be collected each year from selected sites over the landfill foot print and adjacent areas. Samples to be analysed for

analytes detailed in Table 11. Samples shall be collected according to documented procedures and the first sample event shall be performed co-jointly with Gunns environmental staff and a specialist consultant. Thereafter the consultant shall periodically audit Gunns staff to ensure compliance to procedures. For further detail refer to Implementation Section.

Data Review

Water quality data will be reviewed from the baseline surveys and pre operation monitoring, to gain an understanding of surface background conditions. In addition, site locations and sampling frequencies of these programs are to be critically assessed to determine their suitability for incorporation into the operational monitoring program. Any change to the stormwater or leachate engineering design between pre operation and operation phases are to be reviewed, and if required, changes to sample site locations or sample frequencies, should be applied to the monitoring program.

Sampling Design Development

In accordance with the *Landfill Sustainability Guidelines 2004*, and the RPDC requirements, surface water sampling points will be established at the point of surface water discharge from the landfill to the dedicated sediment ponds on the pulp mill site, as well as upstream and downstream from the landfill. For leachate, monitoring locations will be established in the leachate collection sump at the base of the landfill liner.

Implementation

Surface water and leachate must be monitored on a regular basis to detect and respond to any pollution from the landfill, and to demonstrate compliance with any statutory requirements.

The samples will be collected at frequency and for parameters detailed in Table 8. A suitably qualified person will collect the samples. Sample collection, handling, storage and dispatch procedures will be in accordance with the *AS 5667.1:1998 Water Quality – Sampling – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* and *AS 5667.10:1998 Water Quality – Sampling – Guidance on sampling of waste waters*. All samples will be collected, stored and analysed under strict QA/QC protocol.

The samples will then be sent, under appropriate quality control storage and handling conditions, to a NATA registered laboratory or a laboratory approved by the Director for analysis (see Section 4.7 for more details). Parameters will be tested in accordance with the test methods specified in the RPDC Emission Limit Guidelines or other equivalent methods approved by the Director.

Statistical analysis will be undertaken once data has been recorded. Analysis and interpretation of data will require a range of statistical techniques necessary to determine the significance of spatial and temporal differences observed in target parameters recorded during the operational phase.

Table 11: Sampling Schedule for Surface and Leachate Monitoring at the Landfill Site

Monitoring Parameters	Monitoring Frequency	Trigger Value ¹		Emission Limit
		80% Protection	95% Protection	
pH*	Quarterly			-
Conductivity*	Quarterly			-
TDS*	Quarterly			-
Redox Potential (Eh)	Quarterly			-
Turbidity	Quarterly			-
Total Suspended Solids (TSS)*	Quarterly			-
Alkalinity (as CaCO ₃)*	Quarterly			-
Total Nitrogen	Quarterly			-
Ammonia	Quarterly	-	320 µg/L	
Nitrate	Quarterly	-	700 µg/L	
Nitrite	Quarterly			-
Total phosphorus	Quarterly			-
Orthophosphate	Quarterly			-
DOC	Quarterly			-
COD	Quarterly			-
<i>E. coli</i>	Quarterly			-
Total CN (as CN)	Quarterly	-	7 µg/L	
Total iron & dissolved iron (Fe)	Quarterly			-
Aluminium (Al)*	Quarterly	-	55 µg/L	
Copper (Cu)	Quarterly	-	1.4 µg/L	
Zinc (Zn)	Quarterly	-	8.0 µg/L	
Chromium	Quarterly	-	Cr III- ? Cr VI- 1.4 µg/L	
Manganese (Mn)*	Quarterly	-	1900 µg/L	
Nickel (Ni)	Quarterly	-	11 µg/L	
Lead (Pb)	Quarterly	-	3.4 µg/L	

Monitoring Parameters	Monitoring Frequency	Trigger Value ¹		Emission Limit
		80% Protection	95% Protection	
Chloride	Quarterly			-
Calcium	Quarterly			-
Sulphate*	Quarterly			-
Sodium (Na)*	Quarterly			-
Potassium (K)	Quarterly			-
Magnesium (Mg)	Quarterly			-
Arsenic (As)	6 monthly	-	As III- 24 µg/L As V- 13 µg/L	
Mercury (Hg)	6 monthly	-	0.6 µg/L	
Selenium (Se)	6 monthly	-	Total - 1 µg/L	
Total Petroleum Hydrocarbons (TPH) *	6 monthly			-
XBenzene	6 monthly	-	950 µg/L	
Toluene	6 monthly			-
Ethyl-Benzene	6 monthly			-
Xylene	6 monthly			-
Polynuclear aromatic hydrocarbons *	Yearly			-
Organophosphate pesticides	Yearly			-
Organochlorine pesticides	Yearly			-
Polychlorinated biphenyls (Total PCBs)	Yearly			-

¹ ANZECC & ARMCANZ (2000) Australian Guidelines for Water Quality Monitoring and Reporting- Protection of Aquatic Ecosystems in Fresh Waters

*Applies to surface waters and soil only (Section 3.6.2)

Pulp Mill Site Monitoring

The monitoring of surface waters and soils from the pulp mill site will consist of a 4-stage process, to ensure detailed analysis and statistical rigour is achieved. This is summarised by:

- ▶ 2.5 yr Pre Operational Monitoring Program;

- ▶ Data review of baseline and pre operational monitoring;
- ▶ Sampling design development- sampling locations, frequency and parameter identification; and
- ▶ Program implementation.

Pre Operational Monitoring Program

It is proposed that surface water samples shall be collected in natural water courses upstream and downstream of the pulp mill site and collected mid season to ascertain seasonal effect. If the stream is flowing or stagnant at time of collection it is to be noted.

Soil samples shall be collected each year from selected sites over the pulp mill foot print and adjacent areas.

Samples to be analysed for analytes detailed in Table 11. Samples shall be collected according to documented procedures and the first sample event shall be performed co-jointly with Gunns environmental staff and a specialist consultant . Thereafter the consultant shall audit Gunns staff to ensure compliance to procedures. For further detail refer to Implementation Section.

Data Review

Water quality data will be reviewed from any baseline surveys and pre operation monitoring, to gain an understanding on surface background conditions. In addition site locations and sampling frequencies of these programs are to be critically assessed to determine their suitability for incorporation into the operational monitoring program. Any change to the stormwater engineering design between pre-operation and operation phases are to be reviewed, and if required, changes to sample site locations or sample frequencies, should be applied to the monitoring program.

Sampling Design Development

Surface water from the pulp mill and wharf facility will be collected into a surface run-off system, clarified in dedicated settling ponds and re-used. During excessive rain events, (1in 10 yr rain event) it will be discharged via settling ponds to the Tamar River. Surface water sampling points will be established at the point of discharge from the ponds to the Tamar River. Surface water will also be sampled from upstream of the pulp mill and wharf facility sites.

Implementation

Surface water and leachate must be monitored on a regular basis to detect and respond to any pollution from the pulp mill and wharf facility, and to demonstrate compliance with any statutory requirements.

The samples will be collected at frequency and for parameters detailed in Table 11. A suitably qualified person will collect the samples. Sample collection, handling, storage and dispatch procedures will be in accordance with the *AS 5667.1:1998 Water Quality – Sampling – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* and *AS 5667.10:1998 Water Quality – Sampling – Guidance on sampling of waste waters*. All samples will be collected, stored and analysed under strict QA/QC protocol.

The samples will then be sent, under appropriate quality control storage and handling conditions, to a NATA registered laboratory or a laboratory approved by the Director for analysis (see Section 4.7 for more details). Parameters will be tested in accordance with the test methods specified in the RPDC Emission Limit Guidelines or other equivalent methods approved by the Director.

Statistical analysis will be undertaken once data has been recorded. Analysis and interpretation of data will require a range of statistical techniques necessary to determine the significance of spatial and temporal differences observed in target parameters recorded during the operational phase.

4.4.7 Landfill and Pulp Mill Groundwater Monitoring

Landfill Monitoring

Permanent groundwater monitoring bores have been installed in strategic locations, above and below the landfill footprint, and will be monitored pre and post operation of the landfill site to examine the groundwater levels and quality. These bores were installed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (Land and Water Biodiversity Committee, 2003).

The parameters and the sampling frequency defined in this monitoring program are presented in Table 12, and are in accordance with the Tasmanian *Landfill Sustainability Guide* (2004) groundwater monitoring parameters for secure landfills, the *State Policy on Water Quality Management 1997* and the *ANZECC & ARMCANZ (2000) Australian Guidelines for Water Quality Monitoring and Reporting*.

This program will be conducted from the time of installation, until three years after the commencement of the operations at the landfill site after which the program will be reviewed, unless otherwise approved by the Director. The landfill operator may apply to exclude parameters and/or vary the frequency of sampling after this time if it can be consistently demonstrated that the parameters measured do not pose an environmental risk.

Table 12: Groundwater Monitoring Schedule for the Landfill Site

Monitoring Parameters	Monitoring Frequency	Trigger Value ¹		Emission Limit
		80% Protection	95% Protection	
Bore depth	6 monthly	NA	NA	
Ground water depth	6 monthly	NA	NA	
Static hydraulic head	6 monthly	NA	NA	
pH	Quarterly	6.5 to 8.0		
Conductivity	Quarterly			-
TDS	Quarterly			-
Total Nitrogen	Quarterly			-
Ammonia	Quarterly	2300 µg/L	900 µg/L	
Nitrate	Quarterly	170 000 µg/L	700 µg/L	
Nitrite	Quarterly			-
Orthophosphate	Quarterly			-

Monitoring Parameters	Monitoring Frequency	Trigger Value ¹		Emission Limit
		80% Protection	95% Protection	
Total phosphorous	Quarterly			-
Redox Potential (Eh)	Quarterly			-
DOC	Quarterly			-
COD	Quarterly			-
Total CN (as CN)	Quarterly			-
Sodium (Na)	Quarterly			-
Potassium (K)	Quarterly			-
Magnesium (Mg)	Quarterly			-
Total Iron (Fe)	6 monthly			-
Copper (Cu)	6 monthly	2.5 µg/L	1.4 µg/L	
Zinc (Zn)	6 monthly	31 µg/L	8.0 µg/L	
Chromium (Cr)	6 monthly	Cr III CR IV- 40 µg/L	Cr III Cr IV- 1.0 µg/L	
Manganese (Mn)	6 monthly	3600 µg/L	1900 µg/L	
Nickel (Ni)	6 monthly	17 µg/L	11 µg/L	
Lead (Pb)	6 monthly	9.4 µg/L	3.4 µg/L	
Cadmium (Cd)	6 monthly	0.8 µg/L	0.2 µg/L	
Chloride	6 monthly			-
Sulphate	6 monthly			-
Arsenic (As)	Yearly	As III- 360 µg/L As V- 140 µg/L	As III- 24 µg/L As V- 13 µg/L	
Mercury (Hg)	Yearly	Inorganic- 5.4 µg/L	Inorganic 0.6 µg/L	
Selenium (Se)	Yearly	Total- 34 µg/L	Total- 11 µg/L	
TPH and BTEX	Yearly			-
Polynuclear aromatic hydrocarbons (PAHs)	Yearly			-
Organophosphate pesticides	Yearly			-

Monitoring Parameters	Monitoring Frequency	Trigger Value ¹		Emission Limit
		80% Protection	95% Protection	
Organochlorine pesticides	Yearly			-
Polychlorinated biphenyls	Yearly			-

¹ ANZECC & ARMCANZ (2000) *Australian Guidelines for Water Quality Monitoring and Reporting- Protection of Aquatic Ecosystems in Fresh Waters* in accordance with the Landfill Sustainability Guide (20040)

A specialist consultant in conjunction with Gunns staff shall assist and supervise the first round of sample collection, as well as undertaking ongoing period auditing to ensure that sampling protocols are being followed. For the pre operational monitoring all parameters detailed in Table 12 shall be monitored quarterly to ascertain seasonal effect.

Samples will be collected for laboratory analysis using low flow purge and sample procedures, according to the required frequency for each parameter as specified in Table 12. A suitably qualified person will collect the samples. Sample collection, handling, storage and dispatch procedures will be in accordance with the *AS 5667.1:1998 Water Quality – Sampling – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* and *AS 5667.11:1998 Water Quality – Sampling – Guidance on sampling of groundwaters*.

The samples will then be sent, under appropriate quality control storage and handling conditions, to a NATA registered laboratory or a laboratory approved by the Director for analysis (see Section 4.7 for more details). Parameters will be tested in accordance with the test methods specified in the RPDC Emission Limit Guidelines or other equivalent methods approved by the Director.

Statistical analysis will be undertaken once data has been recorded. Analysis and interpretation of data will require a range of statistical techniques necessary to determine the significance of spatial and temporal differences observed in target parameters recorded during the operational phase.

Pulp Mill Site Monitoring

Five groundwater bores have been installed at the pulp mill site, outside the footprint of the mill and will be monitored pre and post operation of the pulp mill to examine the groundwater levels and quality. These bores were installed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (Land and Water Biodiversity Committee, 2003) and the relevant Australian Standards.

A specialist consultant in conjunction with Gunns staff shall assist and supervise the first round of collection as well as ongoing auditing to ensure that sampling protocols are being followed. For the pre operational monitoring all parameters detailed in Table 12 shall be monitored quarterly to ascertain seasonal effect.

Samples will be collected for laboratory analysis using low flow purge and sample procedures, according to the required frequency for each parameter as specified in Table 12. A suitably qualified person will collect the samples. Sample collection, handling, storage and dispatch procedures will be in accordance with the *AS 5667.1:1998 Water Quality – Sampling – Guidance on the design of sampling programs*,

sampling techniques and the preservation and handling of samples and AS 5667.11:1998 Water Quality – Sampling – Guidance on sampling of groundwaters.

The samples will then be sent, under appropriate quality control storage and handling conditions, to a NATA registered laboratory or a laboratory approved by the Director for analysis (see Section 4.7 for more details). Parameters will be tested in accordance with the test methods specified in the RPDC Emission Limit Guidelines or other equivalent methods approved by the Director.

Statistical analysis will be undertaken once data has been recorded. Analysis and interpretation of data will require a range of statistical techniques necessary to determine the significance of spatial and temporal differences observed in target parameters recorded during the operational phase.

4.4.8 Wharf Facility and Donovans Bay Monitoring

Introduction

The proposed Gunns Wharf facility will be located in Long Reach on the Tamar Estuary. The infrastructure will comprise of a 20 000 m³ warehouse, two marine breakwaters and wharf area with specialised loading facilities. The facility will provide Gunns with storage and export facility for pulp produced by the pulp mill.

Donovans Bay will be crossed by the effluent pipeline, it is anticipated that sediment disturbance will occur during the installation phase.

The operational marine monitoring program will ensure there is minimal environmental impact to the estuarine receiving waters adjacent to the wharf facility during operations. The monitoring program will encompass an assessment of water quality, sediment quality and any introduced marine species within the vicinity.

The monitoring program will commence following the commissioning of pulp mill operations and will encompass the methodologies and sampling design adopted for baseline and pre operational monitoring studies undertaken previously. This will ensure accurate data comparison and statistical methods of the operational monitoring program. The monitoring program will only be implemented after agreement by all regulatory authorities.

Monitoring Design

Important components of the design phase of the operational monitoring program for the wharf facility and Donovans Bay will be to:

- ▶ Establish a 2.5 yr Pre Operational Monitoring Program;
- ▶ Implement baseline and pre-operation monitoring methodologies into the operation program to highlight component sections that may need to be amended;
- ▶ Encompass environmental management guidelines set out by the Port of Launceston in to the sampling design; and
- ▶ Gain approval from DTAE and TasPorts Corporation for the final sampling design.

Monitoring Components

Sources of potential contamination include stormwater discharge, chemical spills and discharge of ballast water. In order to monitor these potential sources of contamination the following components will be monitored to manage environmental impact:

- ▶ Water Quality;
- ▶ Sediment Quality; and
- ▶ Marine Pest Monitoring.

Methodology

As the wharf facility is located within the Port of Launceston boundary limits monitoring will be undertaken in accordance with requirements of TasPorts Corporation.

Each monitoring component will consist of a 3-stage process to ensure detailed analysis and statistical rigour is achieved. This is summarised by:

- ▶ Data review of baseline and pre operation monitoring;
- ▶ Sampling design development– sampling locations, frequency and parameter identification; and
- ▶ Program Implementation.

Pre operational Monitoring

Water samples from the bottom, mid and surface should be collected from two locations at the vicinity of the wharf and one location at Donovans Bay, each season and analysed for:

- ▶ pH
- ▶ Suspended solids
- ▶ Salinity
- ▶ TPH
- ▶ Metals
- ▶ Chlorophyll a

Water Quality

Data Review

Water quality data will be reviewed from baseline surveys and pre operation monitoring to gain an understanding on receiving water background conditions. In addition site locations and sampling frequencies of these programs are to be critically assessed to determine their suitability for incorporation into the operational monitoring program. Any change to stormwater engineering design between pre operation and operation phases are to be reviewed and if required changes to sample site locations or sample frequencies should be applied to the monitoring program.

Sampling Design Development

Chemical parameters that are to be analysed for water quality monitoring at the wharf site should be identical to those contaminants analysed in the Stormwater Management Plan. Chemical parameters are outlined above.

Storm water discharge points are to be identified prior to deciding sampling site locations. Areas adjacent to the wharf area should also be highlighted for areas of contamination. Control sites should not be in the vicinity of the wharf. Sampling frequency should be decided based on results from the pre operation monitoring, rainfall events and seasonal change.

Statistical analysis will be required for the water quality component of the monitoring program. Analysis of the baseline and pre operation monitoring data will have already determined the appropriate number of impact and control sampling stations and the degree of replication within the estuary.

It is anticipated that a balanced nested sample design will be employed for all components of the receiving water monitoring program. This design incorporates equal number of control and impact stations, which enables detailed assessment of within-site variation between site variation among both control and impact locations and comparison of variation between both impact and control locations.

Consultation with DPIWE, DTAE and TasPorts Corporation throughout the design stage process will be of high priority. Regulatory agency approval will be sought prior to program implementation.

Implementation

Water sampling methods should be identical to pre operation monitoring methods. It is envisaged that water samples collected for chemical analysis will be obtained using a Niskin sampler. Physiochemical parameters will be measured using a Yeokal logger, or similar, at pre specified depths. All samples will be collected, stored and analysed under strict QA/QC protocol.

Rigorous statistical analysis will be undertaken once data has been recorded. Analysis and interpretation of data will require a range of statistical techniques necessary to determine the significance of spatial and temporal differences observed in target parameters recorded during the operational phase.

Sediment Quality

Sediment quality is unlikely to change through impact from operational activities, however, product spills may release derivatives of the pulp into the water, and chemical spills directly into receiving waters could contaminate localised sediments.

Pre Operational Monitoring Phase

Sediment samples shall be collected at two locations adjacent to the wharf and from one location at Donovans Bay and analysed for:

- ▶ Metals,
- ▶ TPH, and
- ▶ TOC.

Data Review

Sufficient sediment quality data will be available prior to operation. Survey data should then be reviewed and then used to identify potential requirements for a sediment quality operational monitoring program.

Sampling Design

To ensure there is minimal impact on sediments in the study area it is envisaged that sediment quality should be assessed on an annual basis once operations start. Sample site locations and target parameters should remain identical to previous surveys.

The design and development of the sediment quality monitoring program will replicate principles of sample design, statistical methods and sample location discussed in the receiving waters monitoring program.

As per the receiving waters monitoring component, consultation with DPIWE, DTAE and TasPorts Corporation throughout the design stage process will be of high priority.

Implementation

Sediment samples will be collected during baseline and pre operation monitoring. It is envisaged that any contamination of marine sediments at the study site are likely to be found within the surface layers, therefore sediment samples to a depth 0.5 m will be sufficient. Analysis of monitoring data will be undertaken as described in Section 0 of this document.

Marine Pest Monitoring

The unintended release of ballast water from ships moored at the wharf facility could impact marine ecological communities in the area by introducing marine species not endemic to marine waters. Non-endemic species or pest species have the potential to upset the ecological balance of local communities.

Data Review

A marine pest survey and literature review will be undertaken prior to the operation commencing to identify marine pest species that have been introduced previously. A review of the likely origins of arriving vessels prior to operation should also be undertaken to be able to identify potential pest species that could be introduced into the impact area.

Sampling Design

A qualitative inspection survey will be conducted on an annual basis to identify any pest species during the operation phase. Further surveys will need to be undertaken if a pest species is identified. The survey type, design and frequency will be agreed upon with the TasPorts Corporation, DTAE and DPIWE following species identification and analysis.

No statistical analysis will be required for marine pest monitoring.

Implementation

Marine pest monitoring will be undertaken by deployment of divers or by a towed camera to inspect the study area. Video will be used to record the benthos to help in the identification of species and to provide permanent record. All personnel should be qualified to an advanced level in marine taxonomy. Suspected pest species should be sampled for further identification.

4.5 Monitoring Associated With Construction

Monitoring requirements for activities related to the construction of the mill site and support infrastructure are detailed in Section 3 of this document.

4.6 Social, Economic and Community Effects

The proponent has identified the importance of community involvement in the monitoring of community, social and economic effects. This is displayed in the Ambient Odour Monitoring program presented in Section 0, which includes the formation of a residents group to keep odour diaries.

To undertake this work, and prepare the monitoring and measurement criteria in partnership with the RPDC and Gunns Limited, it is proposed that a Community Reference Group be engaged.

The establishment of this group will enable a meaningful and realistic framework to be prepared, and facilitate an ongoing interface with the community during the construction, commissioning and operation of the project. It is envisaged that the framework will make direct reference to any conditions imposed on the development and the specific measurement criteria adopted. The Community Reference Group would also enable mitigation or remediation measures to be explored and agreed with local representatives. It should be noted that the Community Reference Group would also include representatives of local business and industry.

Community involvement will be registered by the ability to report environmental incidents and concerns via the existing Safety Health Environmental System. This system facilitates the recording and management of environmental incidents. The Environmental Incident Reporting System is detailed in Section 4.7.3.

4.7 Implementation, Quality Assurance and Review

4.7.1 Implementation and Quality Assurance

It is the responsibility of Gunns to implement, maintain and continuously improve and Operational Monitoring Program. All sampling will be undertaken by suitably qualified and experienced personnel, in accordance with the relevant standards and guidelines, including:

- ▶ Recommended environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania 2004, Volume 2(RPDC Emission Limit Guidelines);
- ▶ Tasmanian Environment Protection Policy (Air Quality) 2001;
- ▶ USA Code of Regulations: Title 40- part 60, Appendix A;

- ▶ ANZECC & ARMCANZ (2000) Australian Guidelines for Water Quality Monitoring and Reporting;
- ▶ AS 5667.1:1998 Water Quality – Sampling – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples;
- ▶ AS 2923-1987 Ambient air - Guide for measurement of horizontal wind for air quality applications;
- ▶ AS 2922-1987-Ambient Air Guide for Siting of Sampling Units;
- ▶ AS/NZS 5667.9:1998, Water quality - Sampling - Guidance on sampling from marine waters;
- ▶ Australia and New Zealand Food Standards Code;
- ▶ AS 5667.10:1998 Water Quality – Sampling – Guidance on sampling of waste waters;
- ▶ Landfill Sustainability Guidelines 2004;
- ▶ Minimum Construction Requirements for Water Bores in Australia (Land and Water Biodiversity Committee, 2003); and
- ▶ AS 5667.11:1998 Water Quality – Sampling – Guidance on sampling of groundwaters.
- ▶ Need to add the state water quality objectives

Gunns Quality Assurance System

Gunns chip-milling, sawmilling, and forestry operations are ISO14001 accredited and the intent is that the proposed pulp mill will also be fully accredited.

Gunns already has in place a database for recording environmental and safety incidents and public complaints. This system will be extended to the proposed pulp mill.

Management review, which is an integral part of ISO14001, will ensure that all incidents and complaints are thoroughly investigated and resolved.

Field Sampling QA/QC

Rigorous Quality Assurance and Quality Control (QA/QC) procedures will be implemented throughout all sampling activities undertaken on this project. Of primary importance will be the adoption of consistent and repeatable sampling techniques/methodologies and risk minimisation strategies throughout the entire sampling program. These procedures will include:

- ▶ Use of the appropriate sample storage containers and preservation techniques (use of laboratory-supplied storage containers, use of appropriate preservative reagents, storage of samples to the appropriate temperatures).
- ▶ Elimination of the risk associated with sample cross contamination and field contamination through use of stainless steel sampling instruments (sediment grabs), and implementation of decontamination procedures (triple rinses with seawater and phosphate free detergents) between each sampling event;
- ▶ Implementation and review of sample register documentation, which will include field conditions (weather, tides, currents), station locations, sampling methods and handling and storage methods, field numbers, date, time, sample identifiers and sample characteristics. Sample register documentation will be reviewed internally prior to demobilisation to the next sampling station;

- ▶ Implementation of appropriate sample documentation and preservation procedures during sample storage, dispatch, and transportation. This will include use of chain-of-custody (COC) documentation, which will accompany each sample throughout dispatch. COC documentation will specify sample identifiers, the required analyses and detection limits. Accompanying each sample batch will be temperature thermometers that will record minimum and maximum temperatures from the point of dispatch to the laboratory door. After receipt by the lab, the COC will be checked by the laboratory and returned to the sampling personnel;
- ▶ Use of sample splits and sample duplicates (replicates) for QA/QC purposes is an integral component of our sampling program for each of the survey locations. These will be taken at each site according to the specified scope of works (refer to sample design for each location); and
- ▶ Trip Blank samples with contaminant concentrations below detection limits will accompany samples over the course of the fieldwork and will be submitted to the primary laboratory for analyses. Trip blanks provide an indication of possible contamination introduced during sample transport and handling. Trip blanks will be analysed at an approximate rate of 1 per batch of 20 water samples submitted to the laboratory.

Analytical Laboratory QA/QC

The nominated primary laboratory will implement internal QA/QC procedures consistent with the Australian National Association of Testing Authorities (NATA) accredited methods in accordance with their certified quality assurance systems, or otherwise approved by the Director. The analysis will be undertaken in accordance with methods detailed in the RPDC Emission Limit Guidelines or alternatives approved by the Director.

The nominated laboratory will implement the following QA/QC procedures, as specified from their internal QA/QC documented operating procedures.

As a minimum, the laboratory will run the following test methods for all sample batches:

- ▶ **Method Blanks** will be prepared with each batch to make certain contamination does not occur during the sample preparation procedure;
- ▶ **Laboratory Control Sample (LCS)** will be run within each batch of samples at the rate of one every twenty (20) samples or 1 per batch if sample numbers are < 20;
- ▶ **Matrix Spike & Matrix Spike Duplicate** Will be measured within each batch of samples at the rate of every twenty (20) samples or 1 per batch if sample numbers are < 20; and
- ▶ **Test Samples** will be replicated at the rate of one, plus every ten (10) samples or 1 per batch if sample numbers are < 20.

Instrument Calibration

All instrumentation will be calibrated prior to sample analysis. Results from calibration curve for each instrument will be assessed using linear regression analysis. The calibration is acceptable if the R^2 is greater than 0.999 and the absolute value of the intercept is less than the method detection limits (MDL) for the target analyte. If these conditions are not met, then the laboratory may not report data analysed under that calibration and must recalibrate the instrument.

Working Calibration Check Solution

Run the continuing calibration solution immediately after the calibration standards have been run, followed by a blank. Run the calibration verification solution followed by a blank after every 20 samples. Proceed with the analysis if the concentrations of target analytes are within 30% of their nominal values. If this fails, either recalibrate the instrument or prepare a fresh standard, and repeat the analysis.

Sample Carry-over

Check for the possibility of carry-over or cross-contamination if a low-level analyte is analysed immediately after a sample with a high level (about 100 times) of analyte.

Sample Blank

Analyse at least one blank at the beginning of the sample sequence. Ensure that blank values do not exceed method detection limit for each analyte. High blank values are indicative of contamination or instrument malfunction and must be investigated and corrected before proceeding with the analysis.

Replicate Results

Replicate results should be within 20% RPD of the mean of the two results.

Relative Percent Difference (RPD) is calculated by the following:

$$RPD = \frac{(x_H - x_L)}{\bar{x}} \times 100$$

Where x_H = highest result

x_L = lowest result

\bar{x} = mean result

If replicate results exceed the 20%RPD criteria, repeat failed replicates and 10% of the samples in the batch along with new QC samples

Matrix Spike and Matrix Spike Duplicate

A laboratory sample is weighed twice to produce two subsamples. A known amount of analyte is added to each subsample and extracted individually to two separate extracts. Results from the ensuing analysis will assess the performance of the method on a given sample matrix. The concentration of analytes would depend on the concentration of target analytes in the sample, e.g. add 50 µL 5 mg/L independent matrix spike solution (different Lot / Batch No from calibration standards) to 20 ml sample extract.

Replicate results within 20% RPD of the mean of the two results

Percent recovery is calculated by the following:

$$\text{Percent Recovery} = \frac{x_A - x_B}{T} \times 100$$

Where

x_A = Result after spiking

x_B = Result before spiking

T = True concentration of spike

Relative percent difference between duplicates.

Calculate the relative percent difference (RPD) between the MS and MSD results according to the equation below using the concentrations found in the MS and MSD.

$$\text{Relative Percent Difference} = \frac{|D_1 - D_2|}{D_1 + D_2} \times 200$$

Where

D_1 = Concentration of the analyte in the MS sample

D_2 = Concentration of the analyte in the MSD sample

Calibration Standards

When new calibration standards are made, the new standard is checked for accuracy against the old standard. The acceptance criteria for new versus old comparisons is $\pm 5\%$. Details are recorded in the appropriate logbook.

General

- ▶ Check the quality control data to ensure sample analysis is successful.
- ▶ All reported results are quoted to be reproducible to within 10% with a 95% confidence at concentrations greater than 50 times the detection limit.
- ▶ All quality control and blank samples are recorded and graphed to monitor their value trends.

Sample Dispatch

To ensure all sample register, storage and handling and transport procedures are undertaken with minimal risk of sample loss or breakage personnel undertaking the sampling program must implement the following Quality Control Protocols prior to and during field surveys:

- ▶ Pre-labelling all sample containers prior to dispatch;
- ▶ Inspection of the packaging of each sample container to ensure each bottle and vial is individually bubble wrapped or placed in a foam jacket prior to dispatch to and from each sampling location.
- ▶ Headspace in each cool box will be minimised with appropriate packaging to avoid breakage during transit to and from each sampling location.

- ▶ COC documentation for each sample batch will be completed and signed for each shipment. Consignment notes will be allocated for each sample batch, facilitating accurate sample tracking while samples are in transit.
- ▶ All samples dispatched to laboratories will be sealed in cool boxes with either blue ice blocks or dry ice. Each container will be sealed and taped with all appropriate documentation attached.
- ▶ As a further contingency to insure against accidental sample loss or breakage during transit, replicate samples should be taken for each parameter at every sample location, in addition to duplicate samples required as part of the field-sampling program. These replicate samples will only be analysed if required (i.e. breakage or loss in transit of primary samples occurs).

Results Analysis and Data Assessment QA/QC

While each of the nominated laboratories will undertake a QA/QC assessment of sample results, these will be independently reviewed and assessed by suitably qualified personnel. The data quality of laboratory results will be assessed for the entire program by analysis of the following parameters.

Comparability

Assessment of comparability will be achieved by maintaining a high level of consistency in techniques used to collect, store and transport samples and ensuring analytical laboratories use consistent analytical techniques and reporting methods where possible. Reporting of results will be undertaken in SI units and nomenclature.

Laboratories should utilise the same recognised analytical methods for analysis of water samples for the following parameters as prescribed by the RPDC Emission Limit Guidelines.

Furthermore, all results should be compared to previous baseline studies and emission modelling reports where appropriate, including:

- ▶ Aquenal (June 2005), Gunns Ltd Pulp Mill, Marine Biological and Pollutant Survey at the Proposed Outfall Site, For GHD Pty Ltd & Gunns Ltd;
- ▶ Aquenal (September 2005), Gunns Ltd Pulp Mill Outfall, Marine Ecological Monitoring Program, First Pre-Operational Survey April 2005, For GHD Pty Ltd & Gunns Ltd;
- ▶ GHD Pty Ltd (December 2005), *Proposed Bleached Kraft Pulp Mill in Northern Tasmania, Kraft Pulp Mill - Noise Assessment*, for Gunns Ltd;
- ▶ GHD Pty Ltd (February 2006), Draft Proposed Pulp Mill- Bell Bay, Impact on Air Quality, Report-Interim IIS, for Gunns Ltd; and
- ▶ Pitt & Sherry (2005), Gunns Pulp Mill Solid Waste Landfill Conceptual Design, Progress draft 16/06/2005 11:52 AM (Rev D), for Gunns Ltd.

Precision & Data Representativeness

Calculation of the Relative Percent Difference (RPD) between laboratory duplicates and field replicates (analysed at a separate certified analytical laboratory) will be undertaken to determine the precision of laboratory data. Laboratory duplicates (that is, splits of a single mixed sample) should be within an RPD of $\pm 35\%$. If not, any batch of samples where the RPDs fall outside these limits are to be flagged as estimates.

Note however, that variation can generally be expected to be higher for organic analyses than for inorganic analyses, and for low-level concentrations of analytes.

Field replicates (that is, two separate samples taken at the same location) should agree within an RPD (or for three samples at the one location, the relative standard deviation, RSD) of $\pm 50\%$. RPD variation in sediment samples may also be attributable to sample heterogeneity.

If replicate results are not within the acceptable RPDs, investigation into the cause will be initiated to determine the validity of the data. Should these results seem spurious and stored sample matrices are still within the recommended holding times, then these samples will be re-tested.

Assessment of data representativeness will be enhanced through assessment of data variance from replicate samples collected from the nominated sampling stations.

Accuracy

Evaluation of accuracy will be undertaken by assessment of laboratory spikes results and analyses against reference standards. The accuracy of the laboratory results will be assessed by determining the closeness of the analytical results obtained by a method to the 'true' value. For reference laboratory methods the following levels of accuracy will be required to be within $\pm 15\%$ of:

- ▶ the expected value of a certified reference material of similar matrix; or
- ▶ the value obtained by a separately validated and recognised quantitative method for the sample matrix.

4.7.2 Environmental Auditing

As part of the Gunns Safety Health Environment and Quality Management System, an environmental audit of the project on a 6 monthly basis will be undertaken. The audit findings will be submitted for management review. Internal and external audits shall assess:

Compliance to all legal requirements related to its environmental aspects;

Correct maintenance of a calibration register for all environmental monitoring equipment eg noise meters, ambient air quality instruments, in-stack monitoring equipment etc.; environmental sampling and analyses is performed using appropriate and agreed upon methodologies and the analytical laboratories are NATA accredited and/or approved by DTAE;

If procedures are current and appropriate for the task; and

Compliance with the DTAE permit, and equipment guarantee conditions imposed on the operations.

The following protocol shall be adopted to ensure compliance with 4 (above):

1. All tender documents will reference the appropriate section of the RPDC IIS Final Scope Guidelines and Emission Limit Guidelines against that tender;
2. The Alliance and equipment suppliers during construction, commissioning, and guarantee period shall undergo internal audits by Gunns as well as external audits by specialists as required; and
3. The progressive audits shall ensure that the environmental control and/or monitoring equipment is correctly installed and performs to its guarantee.

Additionally all onsite and offsite contractors shall be required to develop comprehensive Environment, Health, and Safety Plans and for high risk tasks a task specific plan eg Environmental Management Plan for installation of effluent pipe, construction of the wharf, etc.

4.7.3 Environmental Incident Reporting

Reporting of potential or actual environmental incidents is a requirement of the Tasmanian *Environmental Management and Pollution Control Act 1994* (EMPC Act). Reporting of environmental incidents or breaches of the emission limits caused by the Gunns pulp mill may take one of the following forms:

- ▶ Reported to Gunns by people who are not Gunns employees;
- ▶ Reported to DPIWE by people who are not Gunns employees; or
- ▶ Reported to Gunns management by Gunns employees.

All personnel are responsible for their actions on the site, and any environmental or safety related incident must be reported. Gunns will have an incident reporting system for all safety, quality and environmental incidents.

The environmental aspect and impacts register shall consider monitoring requirements associated with normal and abnormal operating conditions, shut-down and start-up conditions, and reasonably foreseeable emergency conditions, DTAE Environment Protection Notice and RPDC Emission Limit Guideline requirements.

As required under EMPC Act, in the event of a breach of an emission limit, Gunns will:

- ▶ Notify the Director, as soon as reasonably practicable but not later than 24 hours, after becoming aware of the release of a pollutant occurring as a result of any incident in relation to that activity, including an emergency, accident or malfunction, if this release causes or may cause an environmental nuisance; and
- ▶ Comply with the Director's requirements on the method of addressing the problem as soon as possible.

4.7.4 Monitoring Contingencies

Monitoring Contingencies

Gunns understands that whilst undertaking the commissioning activities for the mill and its ancillary infrastructure there is the potential for emission limits to be exceeded for short periods. Typically this will be during the fine tuning of mill production and effluent control processes, causing emission monitoring results to not be representative of what would be considered normal operations.

Where there is potential for this variation in emission monitoring results and subsequent exceedence of emission limits the actions outlined in the following sections will be undertaken.

Commissioning

Prior to starting up the new mill or new major items of equipment or technology, Gunns will liaise with DTAE prior to the project start-up date to agree upon the commissioning period that will apply to all applicable emission limit monitoring during that time.

Gunns will take all practicable steps to achieve the emission limits defined, which during the commissioning period will be regarded as targets.

Where it has been identified that emissions will occur during the commissioning period, Gunns will ensure that the monitoring equipment required for the specific emission is in place and fully functional. Where the potential for emission limit exceedences has been identified, the need for increased monitoring frequency will be considered, and where appropriate, implemented.

Other Contingencies

Additional monitoring contingencies have been identified and are applicable to regular activities that are not part of day-to-day operations (i.e. annual shutdowns, unplanned/planned maintenance of significant items of plant, decommissioning).

A requirement of the Gunns EMS (Operational Control) will be to identify potential environmental emissions that may result from these activities and to ensure that emissions are monitored where appropriate.

Emission monitoring (as outlined in this report) that is planned to occur during these activities will be undertaken, additionally, where the potential for emission limit exceedences has been identified, the need for increased monitoring frequency shall be considered, and where appropriate implemented. The dates when the activity occurred will be recorded with the emission monitoring results. This will ensure that any anomalies in the monitoring data can be linked to the activity, and additional controls can be implemented as required.

4.7.5 Gunns Pulp Mill Annual Report

At the end of each financial year, Gunns will be required to submit a Pulp Mill Annual Report to the Director. This document will include an analysis and representation of all data collated as part of the monitoring program for that financial year. It will also detail any breaches of emission limits and environmental incidents, as well as mitigation measures and the longer-term outcomes. This report will provide an opportunity to:

- ▶ Review the data collected;
- ▶ Determine if there have been any changes to the ambient environment;
- ▶ Determine if the environmental standards and emission limits are appropriate to the operation of the Pulp Mill and associated infrastructure;
- ▶ Determine if mitigation measures implemented as result of emission breaches or environmental incidents have been effective in minimising potential environmental impacts or further remedial action is required; and
- ▶ Recommend measures to reduce the potential for emission breaches or environmental incidents.

This report will be a public document, and the detailed nature of this report will be agreed in consultation with DTAE.

4.7.6 Monitoring Program Review

It is a requirement of the RPDC Environmental Guidelines that the Operational Monitoring Program be reviewed one year after commencement of pre-commissioning monitoring and one year after commencement of commercial operation.

The review will:

- ▶ Re-evaluate the monitoring program in light of any new information available on parameters, assays, knowledge or previously unidentified components;
- ▶ Examine the biological conditions at the monitoring stations sampled during the pre-operational phase and through out the probable zone of influence of the effluent; and
- ▶ Assess the mill's performance as well as the relevance/operation of the guidelines or other relevant factors.

After these initial reviews, the monitoring program will be reviewed at no more than 3 yearly intervals as part of the process of continuously improving operational performance.