16 July 2007

Gunns Limited
PO Box 572
Launceston Tasmania 7250

Our ref: 41/16384/00/361141
Your ref:

Attn: Lawson Harding

Dear Lawson

GUNNS Pulp Mill IIS
Additional Monitoring of the Receiving Environment

Following your recent request, we are pleased to provide a summary of the tasks we feel are appropriate for the pre-operational phase of the project. These tasks relate to hydrodynamic modelling and the definition of the mixing zone. In addition, they offer the benefit of addressing in greater detail some of the queries raised during the EPBC and public consultation phase of the project. The tasks relate to monitoring in the field, data collection and numerical modelling. A detailed description of each category of tasks is provided in the following sections.

1 Data Collection

It is recommended to collect the following data, some of which should be available from relevant Agencies and Federal Authorities.

1.1 Tidal Elevations and East Coast Lows

We understand that acquisition of additional tidal elevation measurements is proposed as part of the ongoing collection of data in the vicinity of the proposed outfall. In order to benefit future numerical simulations, we would recommend that tidal elevation data is also obtained:

» for the period extending from 2000 to the end of the proposed field monitoring campaign;

» at locations as close as possible to the four corners of the outer numerical model (to be specified); and

» from major ports in the vicinity of the outfall (Burnie, Devonport, Georgetown) and at one or two locations along the Victorian Coast.

1.2 Winds

As was done for the previous modelling work, we suggest the acquisition of:

» Time- and space-varying wind fields generated by the BOM at 6-hour intervals; and

» Land-based (Low Head meteorological station) for the period of the proposed field campaign.

1.3 Wave Data

It is proposed to acquire:

- WAM model data at resolution of 0.125 degrees for the period extending from 2003 to the end of the proposed field monitoring campaign;
- Wave data obtained from the Bureau of Meteorology consisting of visual observations of the sea state off Low Head for the same period (2005 to the end of the monitoring campaign);

1.4 Meteorological Data

Meteorological data should include time histories of air temperature and humidity, precipitation, evaporation, solar radiation for the period 2000 to the end of the monitoring campaign. We understand that Gunns has had an Air Quality Monitoring Station (AQMS) producing full met data sets at Rowella (opposite the proposed mill site in the river valley – approx 15 km south of Low Head) for nearly 2 years.

1.5 Salinity and Temperature Data

Gunns have been collecting monthly vertical profiles of various water quality parameters at three main locations once a month for the last six months. This device can easily be used for future data gathering programs. It can be deployed in situ as a point logger or alternately portable profiler.

In addition, we understand Gunns will be purchasing a Seacat profiler to undertake measurements of water quality optical properties around the diffuser when operational. The deployment of this device can also be included in the data gathering program, including configuration of alternate parameter sensors if required.

Suggested data to be obtained includes:

- the datasets referred to in various review comments (e.g. salinity data for the Tamar Estuary from approximately 7 km to 75 km AMTD held by the Tasmanian Department of Primary Industries, Water and Environment (DPIWE); and
- any additional data that may have been collected since the last data collection effort within the frame of this project (possibly under DPIWE custody).

1.6 Freshwater Inflows

Time histories of inflows from the North and South Esk Rivers with corresponding water quality parameters and sediment loads, should sediment transport modelling be required by the Department.

1.7 Sediment

A literature review of this item was undertaken in 2006 with little success. Nevertheless, it is proposed to undertake a second review of the available literature in an attempt to identify typical sediment characteristics. In addition, the characteristics of the particulate matter carried by the effluent should be identified.

1.8 Satellite Data

If any, that could provide information with respect to the distribution of salinity and temperature along the open boundaries of the B grid model.

1.9 Literature

Relevant papers and scientific reports including those that have been referenced by various respondents during the review process.

2 Field Work (Monitoring)

The collection of data with respect to the following physical entities is recommended as part of the ongoing field campaign proposed by Gunns Ltd.

2.1 Currents

It is recommended we deploy one bottom mounted broadband (600 KHz) ADCP at the outfall site for the period of the proposed field campaign and collect time histories of tidal elevation and current magnitude and direction over depth. In addition, the ADCP should be equipped with a multi-directional wave gauge.

Additional monitoring of currents would also be possible using sea glider technology as further explained in Section *2.7*.

2.2 Dye Tracing Experiment

We propose to undertake two dye tracing experiments involving the use of seaglider technology. Details are provided in Section *2.7.*

It is has also been suggested by one of the reviewers that aerial photographs be taken during the duration of the experiment, at 10 to 15 minutes intervals, subject to visibility of the dye patch(es). The intended use of the aerial photographs is to define the evolution of the perimeter of the dye patch with time and to then crosscheck the interpretation of results obtained using seaglider technology. It is noted that the aerial photographs are not suitable for the provision of a detailed description of the three-dimensional structure of the patch (i.e., vertical mixing) within the water column.

It would be advisable to contact several contractors in the area in order to check if an existing or planned job is in progress. This would reduce the cost of collecting the data.

The results from the dye tracing experiment will assist in greater definition of the characterization of the vertical and horizontal dispersion in the region of the proposed outfall as well as the selection of appropriate modelling parameters. We envisage that this would also provide validation as to the level of conservatism adopted in previous work.

2.3 Waves

The ADCP should be equipped with a multi-directional wave gauge and provide time-series of significant wave height, peak period, peak direction, water level, and height spectra to ensure that extreme events are captured.

2.4 Water Quality

For the purposes of better defining the mixing zone, in accordance with the Guidelines, it is proposed to obtain background levels for key water quality parameters at the outfall location and at environmentally sensitive areas (those not accessible by seagliders). Included in this exercise should be the preparation of vertical profiles of salinity, temperature, turbidity, Chlorophyll a, DO, BOD, COD, Chlorate.

It is understood that GUNNS environmental team will be collecting data for the above parameters.

Measurement of the above water quality parameters would also be included as part of the implementation of seaglider technology.

2.5 Freshwater Inflows

The assumption here is that this data will be provided by the appropriate government agency, and as such is excluded from the proposed list of data to be collected.

2.6 Sediment Characteristics

Sediment sampling should be undertaken at a couple of locations within the Tamar River Estuary and at the site of the proposed outfall.

Required deliverables from the analysis of the data should include:

- graphical representations of particle size distributions in the form of size frequency histograms or cumulative frequency curves
- all raw data used to obtain the above
- Percentage gravel, percentage sand, percentage silt and percentage clay;
- the commonly used percentiles d10, d16, d35, d50, d65, d84, d90;
- mean particle size,
- sorting coefficient
- skewness
- modal size
- kurtosis
- specific gravity of the samples - the specific gravity of a sample is the ration of the mass of a given volume of material to an equal volume of distilled water at the same temperature.
- settling velocities (typically determined from at least 15 samples)
- report with conclusions re all of the above items; the conclusions become part of the data section of the hydrodynamic report

2.7 Use of Seaglider Technology

GHD recommends undertaking of the following additional fieldwork activities:

- Deployment of an autonomous underwater vehicle (AUV) called the Seaglider to continuously map the spatial distributions of temperatures, salinity, turbidity, oxygen, chlorophyll a and characteristic currents through the water column over 1-3 months in winter and summer to serve as validation data (shorter deployments) and possibly boundary conditions (longer deployments) for modelling the proposed outfall region;
- Carry out rhodamine dye release experiments during the winter and summer Seaglider deployments for approximately 3-5 days to characterise the vertical and horizontal dispersion in the region of the proposed outfall;

- Collection of approximately 10 water samples in the proposed outfall region during the Seaglider deployment and retrieval activities with subsequent lab analyses to verify the measurements from the Seaglider sensors; and
- Optionally, deployment of the Seaglider up the Tamar River Estuary to provide validation data for modelling efforts in this region.

This field collection program has been designed to serve as validation and possibly boundary condition data to reproduce the fate and transport of the water masses in the region of the proposed outfall. Specifically, the Seaglider will support the modelling activities by providing data to:

- Estimate the vertical and horizontal eddy diffusivities from the dye experiments, and if possible from salinity, to serve as model parameters for the numerical modelling of the small model domain;
- Validate of D grid hydrodynamic model during winter and summer, specifically the temperature, salinity and vertically integrated currents;
- Validate the boundary conditions of the D grid model domain derived from the parent model domains to ensure their suitability and accuracy; and
- Provide boundary condition data (temperature, salinity and vertically integrated currents) to serve directly as boundary conditions for the small model domain.

Seaglider information sheets are provided as attachement.

3 Modelling

The data collected during the field monitoring campaign will be used for further calibration and validation of the model, as part of the process of refining the mixing zone. The data will further strengthen the ability of the model to predict discharge behaviour for a greater range of conditions, with results to be provided over similar or larger spatial and temporal extents, as required. The extent will need to be agreed prior to the commencement of this phase.

3.1 East Coast Lows (Low Frequency Motion)

A series of tasks are planned which include:

- visualisation and analysis of measured tidal signal at the sites selected for the analysis;
- establishment of lagged correlations of water levels between these sites;
- generation of the combined (tide and low-frequency motion) signal at the boundaries of the large-scale B grid model using the above lagged correlations;
- undertaking of all operational runs with the effects of low-frequency motion taken into consideration;
- comparison of the effects of East Coast Lows at designated locations along the Tasmanian and Victorian coasts in order to verify associated assumptions adopted during earlier stages of the project.

3.2 Waves

We propose to undertake analysis of the combined action of currents and waves over a period of one month at a minimum. The relevant set of conditions will need to be discussed and agreed.

3.3 Winds

The proposed analysis will include the effects of time- and space-varying winds, as previously done.

3.4 Spatial and temporal extent of modelling

It is proposed to preserve the original spatial extent of the modelling with coverage of the models as shown in Table 1:

Table 1 Components of the Modelling System Adopted for the Assessment of the Impact of the Outfall in the Five-Mile Bluff Region

	B	C	D
Extent	490 x 455 km	140 x150 km	27x27 km
Mode of Operation	2D, depth-averaged	2D, depth-averaged	Variable, 50 m to 125 m range
Vertical Resolution	N/A	N/A	5 layers

It is proposed to increase the temporal extent for the modelling to 12 months in accordance with the comments made by several respondents.

3.5 Sediment Transport

Sediment transport is required to address a number of issues raised by the Reviewers. Sediment transport will focus on three types of particles at minimum – typical in-situ sediment at the proposed outfall site, typical sediment from the Tamar River estuary and particulate matter introduced into the receiving waters with the effluent.

3.6 Freshwater Inflows

Freshwater flows were included in the original work. However, if new salinity data is made available, then daily freshwater flow data should be incorporated in the model for the period of modelling.

4 Supporting Comments

The proposed three major categories of tasks (data collection, field work and modelling) are:

» inherently linked, i.e., a good data collection and field work program will facilitate detailed modelling results; and

» sequential, i.e., monitoring and data collection activities precede the modelling process thus ensuring the availability of concurrent data for the modelling process.

In addition, the following conditions are stipulated:

» monitoring and data collection activities should be organised in a field data collection program with clearly identified targets and outcomes;

- the field data collection program should be in agreement with the requirements of the regulatory Agency and ideally approved by the latter prior to its commencement.
- the program should clearly specify all environmentally sensitive areas of concern and water quality objectives thus resolving potential issues with detection levels and instrumentation;
- the field data collection program should be undertaken by certified professionals wherever relevant;
- at the completion of each task, the field data should be visualised, interpreted, with associated conclusions reported and reviewed to ensure that any potential implications for the modelling component are properly identified and accurately assessed;
- field monitoring should be undertaken for a sufficiently long period that captures seasonal variations and extreme events and provides two separate historical periods for calibration and validation of the models. A one year period is suggested for some of the parameters.
- consultations with representatives of the scientific community should be carried out when deemed necessary.

Yours faithfully
GHD Pty Ltd

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