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UniQuest Project No. **14611**

Report Prepared for: **Ms Pam Scott**
Resource Planning and Development Commission
GPO Box 1691
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Subject: **Peer Review Regarding an Integrated Impact Statement**

Part B – Review of Volume 10 of the Gunns' Report

Date: **13 November 2006**

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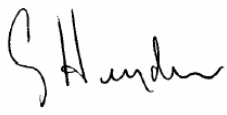
Signed for and on behalf of UniQuest Pty Limited



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Mr Gary Heyden

EXECUTIVE SUMMARY

This report reviews the risk assessments prepared by Toxikos Pty Ltd for GHD for Gunns Ltd of their proposed construction of a pulp mill in the Tamar Valley. Risk assessments are presented in two chapters of volume 10 dealing with air emissions and effluent. Risk assessments utilised in both of these exposure scenarios have employed a precautionary approach with conservative safety margins with a view to protection of public health and taking into account the uncertainties involved in the modelled data sets used. The risk assessments are prepared for a development within an industrially and domestically compromised airshed and landscape adjacent to the Tamar estuary.

Within the restrictions of the brief and the modelled data sets provided for this assessment, the authors have utilised sound, standard methodology to provide a reliable evaluation of the impacts of a facility which has yet to be constructed. The modelled impacts of the air emissions suffer from using only a subset of criteria pollutants. The current level of pollution in George Town for these pollutants is substantial and probably contributes to human health impacts at present. Construction of this pulp mill would add to this level of pollution. Future risk assessment needs to take other pollutants into account. The planned release of effluent 3 km offshore has been shown to be unlikely to have direct impacts on human health.

This is largely because of the dilutional factors associated with effluent release into a very large volume of distribution in the Bass Strait. Nevertheless some components of likely exposure such as the consequences of presence of nutrients need further evaluation. The overall conclusions of the risk assessments are likely to provide for protection of human health.

INFORMATION PROVIDED

The National Research Centre for Environmental Toxicology was provided with a number of documents primary amongst these are volume 10, appendices 22 and 23 and the Executive Summary of the Draft Integrated Impact Assessment (IIS) and the final scope guidelines from the Integrated Impact Assessment. We have also been provided with a CD of the complete IIS and copies of the appropriate sections of these documents. The final scope guidelines for the Integrated Impact Statement gives the health impact assessment in the scope of work under section 7.7. This includes consideration of waterborne emissions under section 7.8.1 and the atmospheric emissions under 7.8.2. In respect of the waterborne emissions, appendices 22 and 23 cover the human health impacts. The ecological impacts which are listed under the various bullet points in section 5, 6 and 7 are dealt with elsewhere. The report 'Review of Toxicological Appendices in the Gunn's IIS Report', which was prepared for the Resource Planning and Development Commission Tasmania by Beca AMEC, was also considered.

SCOPE OF THE REVIEW

The review will include advice on:

- Adequacy of how the draft Integrated Impact Statement, IIS, addresses the issues set out in the guidelines. Is it adequate for the RPDCs assessment purposes?
- Validity of methodology and findings
- Whether the proponent conclusions are reasonable and scientifically based
- Identification of any major or critical errors or omissions in the draft IIS and specification of further work that is required

No comment will be made on the potential for uptake of organochlorine compounds and impacts on nearby seal colonies.

1. HUMAN HEALTH RISK AND TOXICOLOGICAL ASSESSMENT OF BELL BAY PULP MILL, AIR EMISSIONS AND EFFLUENT

In the past paper mills have been renowned for the releases of both airborne and waterborne pollution. It is therefore understandable that proposals for the construction of new Pulp Mills raise anxieties in inhabitants of the area associated both with nuisance and with health impacts associated with mill operations. The proposed mill at Bell Bay is being constructed in an area in which there are already substantial numbers of industrial operations. It is therefore appropriate that a health risk assessment was commissioned by the proponents of the mill to evaluate potential impacts on the population. The background to commissioning of this report and matters relating to pulp mill operation and discharges is covered at length in the report, summaries and comments and further input on this is not necessary.

This current review evaluates the two parts of the health risk assessment presented in volume 10 of the report. The first part deals with airborne emissions and the second with mill effluent.

The Erratum

Both of these reports have been competently carried out by Toxikos Pty Ltd. It is therefore regrettable that subsequent to publication of the report, an erratum had to be presented as a consequence of a transcription error. In the Erratum changes to figures such as the change in incremental dioxin increase in fish from 0.18 to 8.3 pg TEQ/kg fish– a 46 fold increase belies the competence of the rest of the report.

With a view to clarifying the consequences of these mistakes I shall deal with the erratum first, prior to commenting on each of these reports. The fundamental consequence of the mistake has been to substantially increase the measure of combined dioxins and furans (picograms TEQ dioxins). This has meant that the concentration in fish has notionally increased almost fifty fold. Whilst this seems a very large rise, in actuality, it is an increase from extremely low levels to very low levels of dioxins in fish. These low figures are unsurprising view of the relative insolubility of dioxins in water. Fish, like humans, acquire most of their body burden of dioxins from their foodstuffs. Unless there are substantial concentrations of water-insoluble dioxins in the effluent sediment transported to fish feeding grounds it is unlikely to be associated with increased levels of dioxins in fish used for human food. The concentrations of dioxins in fish are used in both the first and second reports.

These reports show that fish contribute about 1% of the dioxin intake. Most dioxin exposures linked to dietary fat are un-associated with eating fish. In consequence these modelled contributions by the pulp mill do not make any substantial additional contribution to exposure to dioxins either from food intake or from air emissions or from effluent from the mill.

Emissions Report

The work has been very competently done, and the risk assessments are clear and appropriate within the confines of a brief that is really very restrictive. I use these words advisedly, as I think that considering only SO_2, NO_2 and PM_{10} in the most important S3 scenario is restrictive. One appreciates that the capacity to cover all of the likely pollutants is contingent upon the release of confidential data by other industries. Nevertheless when one considers that airborne pollution of sorts other than criteria pollutants are likely to be an issue, background levels of pollutants, as well as likely added emissions are important, (see 1 & 2 below) in deciding if a project should proceed; there is always a straw to break the camel's back. In general terms the only scenarios that are of real consequence are scenarios 1 and 3. However, in the absence of a suite of information associated with the unidentified emissions from other industrial and domestic operations, scenario 2 becomes important. This is because there is restricted understanding of the baseline upon which the increment is to be added. Risk to health is associated with the total exposure and not with the subset of emissions likely to be produced by the pulp mill.

Methodologies

The methodologies employed in carrying out the risk assessment are appropriate within the Australian context and use internationally accepted standard techniques. A critical question that arises subsequent to use of these methodologies is in respect of the reliability of the data used in them. Since this is a modelling exercise Toxikos properly asked the question of how well the model reflects reality. Conservatively the measures of gaseous pollutants are over-predicted however particulate pollution is under-predicted. This under prediction is consistent with the comments made previously about lack of knowledge of background concentrations of pollutants such as particulates. The methodology is used for hazard identification and summation of the toxicity of these hazards through the use of hazard quotients is appropriate to and explained well. It draws attention to the fact that the hazard index at George Town is greater than 1 in the first and third scenarios. In both cases this relates to high concentrations of particulates in the air.

Evaluation of background emissions shows that modelled pulp mill emissions should have

virtually no effect on air-quality in George Town. The presence of particulates is an important issue in mill operations not only because of the demonstrated health effects of particulates but also because of their capacity to carry other pollutants on their surface. PM_{10} values are a poor surrogate for ultrafine particulates that are likely to be the major impacts on health. More needs to be done in consideration of the presence of particulate pollution through use of other measures of particulates and $PM_{2.5}$.

Emission sources

In consideration of the plant emissions the primary sources of emissions are correctly identified and modelling carried out for these. GHD measured all of the proposed mill air emissions on data provided by Bell Bay Industries; there appears to be no other independent data used or independent checks of the validity of the data. Quality assurance procedures should have been employed including an independent audit of the data sets. In addition to these sources of emissions it would have been appropriate to consider the consequences of unplanned fugitive emissions or unplanned releases by the plant.

This is particularly relevant in consideration or odour events. The likeliest source of community outrage in respect of plant operations will relate to sound and smell. In particular, odour events, unlikely under normal operating conditions, are precisely the issue that is likely to be associated with unexpected abnormal operation of the mill. Since the lowest odour threshold is very similar to the DPIWE design criteria it is entirely possible that TRS concentrations will fluctuate sufficiently during abnormal operation of the plant with resultant odour perception.

This section of the health risk assessment dealing with the perception of smell is particularly well covered and details clearly the annoyance factor, the outrage, which one could expect in adjoining populations. For this reason alone it is particularly important, that should the construction of the mill proceed, there is forward planning of the management odour incidents.

Uncertainties

The final section of the risk assessment deals with uncertainty. It emphasises the inherent conservatism of the risk assessment. It also draws attention to the lack of availability of background information on substances other than sulphur and nitrogen oxides and particulates which may have consequences due to the effects of other constituents in the mill emissions and consequential effects on the respiratory tract. The analysis also draws attention to the lack of availability of information on all sources of emissions from mill. Variations during some stages in the operation such as start up and shut down are equivalent to the previous comments on fugitive emissions. Inherent to this form of risk assessment are some of the fundamental

assumptions that have to be made. Principal among these is the assumption of summation of effect which leads to overestimation of risk. However risk is underestimated in this case, in respect of background emissions, because only the criteria pollutants have been included in scenario 3.

Overall this is a competently prosecuted human health risk assessment with the data available. It is well referenced in the data set is clearly presented in the appendices. It is not impossible to validate these data sets. The section on screening for secondary exposure pathways is particularly helpful and demonstrates that the mill is very unlikely to be a contributor of metals to the food chain or of dioxins or polyaromatic hydrocarbons.

Emissions Report - Specific Comments

1. Page 5. Last sentence including scenarios; I cannot see how a competent "health risk assessment of the emissions" can be done unless scenario 3 applies to all emissions.

2. Page 6. Only SO_2, NO_2 and PM_{10} are considered in S3 as there was no information made available on other possible/likely pollutants; why was data not sought on other emissions?

3. Page 35-36, under 4.1, second paragraph; is it true that "relatively few chemicals……..food chain"? I'd expect some references to back this up. Note reference to Section 7.3, which I can't find in the report.

4. Page 38, second full sentence; these statements re limits to emission species seem very dogmatic.

5. Page 43, second paragraph, sentence 3. "Because this is a preliminary hazard assessment…….rather……than a thorough toxicological evaluation of each chemical"; see also Page 51, last paragraph. These statements indicate that a future more complete assessment should be done.

6. Page 47, paragraphs 1&2; the words "additive" and "interactive" seem to be used as synonyms; is this the case? In the context of what is being discussed, this is surely not correct.

7. Page 50 and following, Section 7. Conclusions re SO_2, NO_2 and PM_{10}, i.e. S3, are satisfactory.
8. Page 69, second paragraph, "Table 7.2" (Table 7.3 doesn't exist).

9. Pages 72-101, Sections 8-11. Mostly a very good and comprehensive literature review. This is very well done.

10. Pages 102-115, Section 12 on odour is fine, although this is a difficult topic to quantify.

11. Pages 116-120 on uncertainties. This is a good summary of the criticisms that can be raised; sometimes I found the answers a bit too dismissive.

2. HUMAN HEALTH RISK ASSESSMENT -BELL BAY PULP MILL EFFLUENT

Critical in consideration of the likely health effects of effluents is an understanding of the exposure pathways to humans. This health risk assessment makes the assumption that the ocean outfall was sufficiently far away from the shore to pose little risk to humans through recreational exposure. It also assumes that the diffusers used will provide for thorough mixing of the effluent in the marine water column.

It would seem reasonably certain that the warmer less dense freshwater effluent would tend to rise towards the sea surface as part of the distribution and dilution process. This would further enhance the mixing in the water column. I have been unable to determine whether currents in this area would be likely to transfer outfall, even if greatly diluted, onshore. However I am encouraged to believe that this does not represent a major hazard since modelling indicates that outside the dilution zone, concentrations of effluents do not exceed recreational water guidelines, where these exist.

Wood types

Risk assessment indicates that the mill proposes to use primarily, eucalyptus hardwood chips. World experience to date has primarily revolved around the use of softwoods such as pine chips or hardwoods of Northern hemisphere origin. It seems likely that effluent characteristics from these two very different types of wood would be different. This would then mean that the candidate list of effluent constituents and following on that, chemicals of interest, might differ from those presented. This is borne out by the information given in appendix 3.

Exposure

The risk assessment therefore concentrates primarily on human consumption of fish. The methods used to establish the concentrations of the pollutants that might be found in the fish are sound, as is the decision is made on the qualitative risk assessment of suite of bioaccumulative metals. These are identified as cadmium mercury and selenium. For each of these there is a good description of their toxicology. Given the length of the list of potential chemicals of interest, it almost seems too good to be true that they can be reduced to Cd, Hg, Se and dioxins/furans for consideration in terms of bioaccumulation. It could have been useful to make some comments on the likelihood of effect of other elements such as chromium and manganese which are in the public eye because of the carcinogenic and tainting effects notwithstanding their failing the bioaccumulation test.

Dioxins and Furans

The emotive nature of exposure to dioxins and furans has meant that the risk assessment contains a section on them which is disproportionately large in consideration of their likely impact as a consequence of mill operations. This has been compounded by the calculation mistakes listed in the erratum statement above. With some 26 pages out of 96 pages devoted to this topic, it is obvious that the authors foresaw the political problems associated with dioxins. Unfortunately, the calculations here, and on pages 196-203, gave results which, when corrected using the errata sheet, give the appearance that the authors believed that with the new industrial process dioxins would not turn out to be a problem. These results depend upon proposed effluent limits being met, and the effluent diffuser working as planned.

On page 63 of TR 081205- RJF a statement is made that 'dioxins are not avidly bioaccumulated and are not biomagnified by marine mammals'. This statement is not correct since the capacity to biomagnify is a species-specific phenomenon which depends upon the position in the Tropic chain of the species. In the context of the relatively low concentrations of the dioxins in this study this is not relevant but could become relevant had there been greater discharges into the marine environment. I believe that, notwithstanding the substantial rise in concentrations of dioxins in the recalculated figures, the authors' conclusions are still sound.

Taint

Tainting of foodstuffs is akin to the impact of odours discussed previously. Like odours, taint can be perceived at very low concentrations. As shown in the risk assessment this has been a common problem with many traditional pulp mills. The suggestion is that most mills have traditionally discharged into lower volume freshwater systems rather than into the larger marine environment. One cannot help but wonder whether the materials found in eucalypts will differ from materials found in northern hemisphere hardwoods with the potential to taint fish. The risk assessment demonstrates that there is a degree of uncertainty in this but that likelihood of taint is small. I concur with this position because of the probability that the freshwater discharge is likely to discourage marine species from entering the discharge plume (see below).

Recreation

The recreational use of water which has been contaminated by the mill is shown to be unlikely because the circumstances associated with its discharge into the estuary. As stated elsewhere I cannot judge whether or not water flows or currents would be likely to direct diluted effluent at sufficient concentrations on to bathing beaches. However without human exposure there can be no risk.

Nutrients

One matter not considered in the risk assessment of effluents is the concentrations of nutrients in the effluent. For example there are substantial concentrations of phosphorus in the final effluent (0.5 to 1 .1 mg per litre) and lesser quantities of nitrate. The presence of nutrients in the effluent would suggest the possibility that marine bacterial and plant growth would be enhanced. The presence of bacteria and cyanobacteria would allow for some biological conversion of the chemicals present and present the possibility of further source of taint. Cyanobacterial blooms carry with them the probability of synthesis of toxins which could impact on human populations.

Uncertainty analysis

The uncertainty analysis is again very helpful in understanding limitations of the risk assessment. The compendium of chemicals considered is large but it was not possible to understand whether this list had in fact fully considered the differences between northern hemisphere hardwoods and eucalypt hardwoods (appendix 1). This must have some impact on constituent composition of the effluent.

A second factor of concern is the knowledge of the dilution design and the actual quantity of the pollution. There has been no consideration in this or of the fact that the effluent water being discharged is a freshwater discharge into a marine saline environment. This is the major consideration in respect of whether sea life will stray into the dilution zone. If anything, it is likely that, for osmotic reasons alone, fish would avoid such an area of low salinity.

This would further lower the likelihood of human exposure through fish foods since the assumption has been that human consumption of fish would only come from sources affected by the outfall. This is an improbable scenario and points to the inherently conservative nature of much of the risk assessment. This includes underestimates of dilution and utilisation of the upper bound of background estimates for 95% background estimations.

In the uncertainty analysis no consideration has been given again to the possibility of catastrophic breakdown in the industrial processes. Foremost amongst these would be the possibility that the discharge line was broken underground prior to reaching the sea with consequent pollution of groundwater. Another catastrophic scenario would be breaking of the pipe close to the shore with undiluted effluent being washed up on beaches.

Effluents Report - Specific Comments

1. Page 31, Section 4.2 Bleaching Chemistry of ClO_2; I didn't appreciate the distinction between elemental chlorine and HOCl in paragraph 2; "elemental chlorine" certainly doesn't occur; it is molecular. Even then, when passed into aqueous solution, chlorine disproportionates to HOCl and HCl. Interestingly, in the emissions report, nothing is said about likely ClO_2 emissions. This should be handled in an on-site hazards report. The chemical is highly toxic, although its reactivity, assuming inadvertent release on-site, would probably preclude problems for any other than mill personnel.

2. Page 32, coupled with Appendix 1 pages 125-145. Shows that the authors have reduced the large range of compounds in Tables A1.1 and A1.2 to the results shown in Table A1.3 (Chemicals of Interest). It is not entirely clear how this was achieved; there is an associated worry that the reference column in this last Table 1.3 has a "Reference" entry as "Estimate". I appreciate that we have little information on many chemicals, but this listing almost suggests that any HRA is an estimate since there are so many compounds for which we have no reference values.

3. Page 34. Exclusion of brominated compounds on basis that there is no "source of reactive bromine"; I think that $NaClO_2$, used on-site to make ClO_2, will contain bromine.

4. Page 89. Last entry in column headed "Effect on RA"; I can't understand where 0.57 pg TEQ/Kg/month comes from.

FUTURE WORK

- Independent quality checks on data competence including an independent audit of the data sets.
- Evaluation of fugitive emissions.
- Better development of the presence of odorous compounds after unplanned and unpredicted outages -- possibly by better understanding of sulphur balance in the feedstock.
- Complete data sets of pollutants other than the criteria pollutants to allow a full evaluation of scenario 3.
- Consideration of $PM_{2.5}$ and ultrafine particulate pollution.
- Consideration of catastrophic breakdown in plant operation in respect of air pollution.
- Outcomes of a catastrophic breakdown in the effluent discharge pipe with consequent impact on groundwater and the marine environment.
- Better data sets which describes differences between eucalypt hardwoods, other hardwoods and softwoods.
- Nutrient analysis and evaluation of the consequences of the presence of nutrients.

SUMMARY

The overall conclusion that one reaches on this human health risk assessment is that it is as good as the dataset used allows it to be. The deficiencies in the completeness of the pollution data from the Tamar Valley, means that the add-ons from the model of the likely production of airborne pollution by the pulp mill has so many uncertainties that it cannot fully predict the detriment in air quality and consequentially, the potential impacts of overall air quality on human health.

It is generally acknowledged that air quality in the Tamar Valley is poor. The geographical situation, presence of temperature inversions and domestic and industrial emissions means the current pollution in the valley is substantial and can be retained there because of these geographical and climatic factors. The risk assessment is not assisted by only having a subset of the criteria pollutants available for consideration in the prediction of human health impacts. In a similar sense, effluent from the mill is wholly dependent on the volume of production and the feedstock used. Lack of specific data relevant to the Australian and Tasmanian situation means that the quality of effluent, and likewise the compounds present it are indeterminate.

This has consequences in application of an appropriate human health risk assessment as much as it impacts on the competence of the ecotoxicological assessment. The purpose of this review is however not to consider the ecotoxicology but to consider the impacts of the airborne emissions and waterborne effluent on human health. The recommendations for further work given above are a minimum to achieve credibility in acceptance of a major industrial expansion.

On the basis of the scope of the review, given above, the following have been addressed:

- **Adequacy** – minimal since it neglects some likely airborne pollutants in the data set
- **Methodology and findings** – sound and applied appropriately
- **Conclusions** – These are reasonable and scientifically based on the data set provided
- **Errors or Omissions** – no critical error or omissions
    - some data deficiency in the draft IIS
    - a listing of further work is provided

REVIEWERS

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Director of the National Research Centre for Environmental Toxicology (EnTox). Michael is a registered toxicologist (Eurotox & Institute of Biology, UK) and Member of the Australasian College of Toxicology and Risk Assessment (ACTRA). He is a co-director of the Australian Centres for Human Health Risk Assessment. As an international expert in toxicology of water pollutants and air pollutants relevant to public health, his areas of expertise include the toxicology of metals, air toxics, risk assessment, alcoholism, cyanobacterial toxins and disorders of porphyrin metabolism. Member of wide range of committees and advisory bodies on public health issues at both Commonwealth and state levels; He chaired the NHMRC Drinking water treatment chemicals working party and was a member of the NHMRC Environmental Health & Nutrition Standing Committee, National Cyanobacterial Toxin Guidelines Working Group and the NHMRC Working party on Toxicology and Risk Assessment. He also represented Australia on WHO committees on Dioxins and several expert task groups of the International Programme on Chemical Safety.

Dr Heather Chapman has significant experience (>25 years) in research relating to management of chemicals in the environment and during the last decade specifically relating to endocrine disrupting chemicals in water. Heather is program leader for the Sustainable Water Sources program of the CRC Water Quality and Treatment and presently leads an international project on development of a toolbox of biological methods for analysing oestrogenicity in water, for the Global Water Research Coalition.

Emeritus Professor Barry Chiswell has co-authored some 30 consultancy reports over the last two decades for both large and small water treatment authorities; many of these have been on aspects of treatment of potable water (both in dam and in treatment plant) for manganese removal, speciation of chlorine and disinfection by-products, and a range of studies on many aspects of catchment management. Reports have also been undertaken upon contaminated sites and waters resulting from leaching from such sites.

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