Cowman Stoddart Pty Ltd
ABN 29 057 616 896

STEPHEN RICHARDSON, M.Appl.Sc.,BTP, Grad.Dip.Env. Mgt,CPP, MPIA
STUART DIXON, B. Urb. & Reg. Plan., CPP, MPIA

Associate:
PETER COWMAN, B.Sc.Agr., MAIAST

Email: info@cowmanstoddart.com.au
Website: www.cowmanstoddart.com.au

Phone: (02) 4423 6198
(02) 4423 6199
Fax: (02) 4423 1569

The Holt Centre
31 Kinghorne St
Nowra NSW 2541

Postal Address:
PO Box 738
Nowra NSW 2541

4 May, 2012

Our ref: 07/31

The Manager – Industry
Department of Planning & Infrastructure
GPO BOX 39
SYDNEY NSW 2011

Attention: Andrew Hartcher

Dear Sir

RE: RESPONSE TO SUBMISSIONS REPORT (RTS)
MODIFICATION NO. 2 – SHOALHAVEN STARCHES EXPANSION PROJECT
(MP06_0228.MOD 2)
PROPOSED CHANGES TO FERMENTATION AND DISTILLATION PROCESS

I refer to the Department's letter dated 27th February 2012 attached to which were submissions received from the Environment Protection Authority (EPA) dated 21st February 2012 and Shoalhaven City Council (SCC) dated 7th February 2012; as well as emails dated 15th March and 24th April 2012 . The Department's letter has requested that Shoalhaven Starches provide responses to issues raised by the EPA and SCC, while the two emails sought further information in relation to this Modification Application. Our firm has been engaged by Shoalhaven Starches to prepare this Response to Submissions (RTS) report addressing the issues raised by these submissions and emails.

EPA

The EPA have requested an assessment of the potential impacts on air quality resulting from the proposed modifications in accordance with the "*Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales"* (DEC 2005) ("the approved methods").

The Environmental Assessment for this modification proposal included an Air Quality Impact Assessment prepared by Stephenson Environmental Management Australia (SEMA).

Shoalhaven Starches have engaged SEMA to prepare a further air quality impact assessment addressing the EPA requirements as outlined above. A copy of this further air quality impact assessment forms **Annexure 1** to this submission.

SCC

Council's submission raises two broad issues concerning:

- Landscaping; and
- Flooding.

Landscaping

Council identifies that Condition 43 of the Project Approval for the Shoalhaven Starches Expansion project required the submission and approval of a Vegetation Management Plan (VMP) for the site and for this plan to be approved by the Director-General of Planning.

Council state in their submission that they are not aware whether this VMP has been submitted and approved. Furthermore they allege that no planting has been carried out.

Annexure 2 to this submission is a copy of the Landscape and Vegetation Management Plan (LVMP) prepared by Coffey Environments that was submitted to the Department of Planning in compliance with condition 43 of the Project Approval. A copy of this document was also supplied directly to SCC by Coffey Environments.

Annexure 3 to this submission is a copy of the Department of Planning's approval for this LVMP.

Furthermore, contrary to the assertion in Council's letter that no landscaping has been undertaken, Shoalhaven Starches have made significant progress in terms of vegetation management in accordance with this approved LVMP. **Annexure 4** to this RTS is an assessment of the progress that has been undertaken in relation to this matter.

In addition, Shoalhaven Starches have engaged the services of Peter Phillips Landscape Architecture to prepare a Landscape Plan for the area situated between the proposed works associated with this Modification Application and Bolong Road. A copy of this Landscape Plan forms **Annexure 5** to this RTS. This Landscape Plan proposes a series of planting beds of dimensions of 3 metres depth and 10 metres length along the frontage of the factory site. The plans propose the planting of a range of native plants, ranging from trees, shrubs and ground covers along the frontage of the site. This landscape scheme will assist in softening the appearance of both the proposed works associated with this Modification Application as well as the existing development on this factory site.

This landscaping will assist in softening the appearance of not only the proposed works when viewed from Bolong Road, but the overall distillery plant when viewed from this location.

Flooding

Council also request that an assessment be provided that the additional structures will not impede the ability of staff to evacuate the site in flood emergencies and or impact adversely on existing residential structures on the floodplain.

Shoalhaven Starches have engaged WMAWater to respond to this issue. WMAWater were responsible for undertaking the original flood assessment associated with the Shoalhaven Starches Expansion Project. A copy of WMAWater's response forms **Annexure 6** to this RTS.

With respect to these two issues WMAWater indicate that:

1. ***Additional structures do not impede the ability of staff to evacuate the site in flood emergencies***

   Shoalhaven Starches has a Flood Evacuation Plan for the site (dated April 2008) which deals with the evacuation of staff during a flood. The additional structures that are included as part of the proposed works will not require additional staff and thus will not increase the number of workers that are required to be evacuated during a flood. Furthermore as best we can determine the proposed structures will not be located in a manner that is likely to inhibit the ability of staff to evacuate the site during a flood in a safe manner in accordance with the Flood Evacuation Plan.

2. ***Impact adversely on existing residential structures on the flood plain***

   Our report of 20th December 2011 states:

   The results indicate that the incremental increase in flood level (for the full range of design flood events) as a result of the proposed works shown on Figure 1 is less than 0.01m. A change in flood level of +/- 0.01m in flood level is within the order of accuracy of the flood modelling process and cannot accurately be defined. This very small increase in flood level is to be expected given the magnitude of the floodplain of the lower Shoalhaven River and the relatively minor extent of the proposed works.

   Our conclusion is therefore that the proposed works will not adversely affect existing residential structures on the floodplain

Duration of Construction Works

The Department of Planning & Infrastructure in an email dated 15th March 2012 requested advice as to the anticipated duration of construction works. Shoalhaven Starches advise that the anticipated construction period will be 9 months.

Noise

The Department of Planning & Infrastructure in an email dated 15th March 2012 also requested information in relation to the anticipated noise associated with construction works. Shoalhaven Starches have engaged the services of Day Design Pty Ltd to address this issue. Day Design prepared the original Noise Impact Assessment that formed Annexure 3 to the Modification Application submission prepared by our firm. Day Design's response to this issue forms **Annexure 7** to this RTS.

The construction works involved will consist predominantly of assembling and erecting prefabricated sections of the fermentation tanks and the distillation plant and according to Day Design will produce very minimal noise emission. The construction works will however involve piling associated with the construction of concrete slabs for the two fermentation tanks using a piling rig. Piling works will occur sporadically throughout the day and last a maximum of two weeks.

The current EPA licence noise conditions relate to the operation of the Shoalhaven Starches site and are derived from previously measured background noise levels during night time hours. According to Day Design these limits are not applicable to noise emission from construction works. Noise emission from construction works in NSW is assessed against the EPA's *Interim Construction Noise Guideline 2009*.

The guideline sets a noise management level, under a quantitative assessment, of background noise level plus 10 dB. Day Design Pty Ltd has conducted numerous noise surveys within the Nowra and Bomaderry areas and has found typical day time background noise levels to range between 40 and 45 dBA depending on the location. This results in a typical noise management level of 50 to 55 dBA for construction noise emission in the area.

To consider the likelihood of noise emission from the proposed construction works as part of the ethanol upgrade Day Design have assumed a sound power level (L_w) for a piling rig of 118 dBA.

According to Day Design the predicted level of noise emission from piling activity at each of the sensitive receiver locations is calculated to be between 42 and 48 dBA depending on the receptor location. Full details of receiver locations can be seen in Section 3 of their Noise Impact Assessment which forms Annexure 3 to the Modification Application submission prepared by our firm.

This noise level is below a conservative day time construction noise management level and considerably less than the highly noise affected level of 75 dBA. Day Design recommend normal construction hours (as defined by the EPA) are maintained during piling works, as follows:

- 7:00 am to 6:00 pm Monday to Friday;
- 8:00 am to 1:00 pm Saturday; and
- No work on Sunday or Public Holiday

Day Design's submission concludes:

> *Given the location, nature and duration of construction works we are of the opinion that noise emission from construction will have a negligible impact on residential receptors for this proposal.*

Distillation Columns

The Department of Planning & Infrastructure in an email dated 24th April 2012 requested advice as to the location of the proposed low pressure distillation columns.

Figure 4 in the Modification Application submission shows the works associated with the new distillation columns and evaporator plant. The three new columns are shown as:

- A New "Beer Column" replacing an older Beer Column D10;
- A second new Beer Column is also shown with a new Heat Exchanger (H504); and
- A new Rectifier Column is also shown and will replace an existing older Beer Column. Also shown is a new side stripper that is part of this Rectifier Column.

These new plant are shown on Figure 4 in red; while existing plant is shown black.

To further assist, **Annexure 8** includes the set of plans that support this Modification Application and on which I have highlighted the three columns associated with the distillation plant connected with this modification proposal.

Fermenters

The Department of Planning & Infrastructure in an email dated 24th April 2012 also request advice as to whether:

- The proposed Fermenters would be constructed on existing hardstand areas? and
- Would any of the proposed works involve excavations and if so, how deep and how would construction impacts be managed (eg. standard erosion and sedimentation controls)?

The proposed two new Fermenters associated with this Modification Application will be erected on existing compacted, all weather gravel hardstand surface.

The construction of the new Fermenters and associated equipment connected with this proposal will require excavations of approximately 1 metre deep to enable the construction of suitable foundations and footings. Standard soil and erosion control measures are consistent with the Statement of Commitments (table 41) of the EA which was submitted for this project approval will be utilised.

I trust the above and attached information is of assistance to the Department. If you require any further information in relation to this mater please do not hesitate to contact me.

Yours faithfully

Stephen Richardson.

Stephen Richardson
COWMAN STODDART PTY LTD

Enc.

ANNEXURE 1

ANNEXURE 1

Further Air Quality Impact Assessment

prepared by

Stephenson Environmental Management Australia

Stephenson
Environmental Management Australia

Peter W Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

Newington Business Park
Unit 7/2 Holker Street
Newington NSW 2127 Australia
Tel: (02) 9737 9991
Fax: (02) 9737 9993
e-mail: info@stephensonenv.com.au

300 Beaconsfield Parade
Albert Park VIC 3206
Tel: 0417 023 140

Level 21, AMP Place
10 Eagle Street
Brisbane QLD 4000
Tel: (07) 3303 8549
Fax: (07) 3303 8445

120 Upper Sturt Road
Glenalta SA 5052
Tel: (08) 8278 2155
Fax: (08) 8278 2199

Level 28, AMP Building
140 St Georges Terrace
Perth WA 6000
Tel: (08) 9278 2582
Fax: (08) 9278 2444

16 April 2012

SEMA Ref No. S 21411
Project No. 5012/12

Mr. Brian Hanley
Manager – Energy & Sustainability
Shoalhaven Starches Pty Ltd
PO Box 123
NOWRA NSW 2541

Dear Mr Hanley,

RE: **Revised Air Quality Impact Assessment:**
Section 75W Modification Application –
Minor Modification to Ethanol Plant,
As part of Shoalhaven Starches Expansion Project MP06_0228
Bolong Road, Bomaderry NSW

Stephenson Environmental Management Australia (SEMA) has reviewed the documentation, including the original Environmental Impact Assessment, subsequent dispersion modelling and drawings associated with this minor modification to the Ethanol Plant. The relevant drawings and photographs are attached to this letter report.

In essence the following conclusions have been drawn from this review and assessment:-

1. Shoalhaven Starches has identified two areas of the ethanol production process which can be modified to improve energy efficiency and better refine operational processes. These areas are Fermentation (operational processes) and Distillation (improved energy efficiency);

2. It is noted that these modifications will not increase capacity of the plant or production capability;

3. **Fermentation Process**: It is also noted it is proposed that two (2) additional fermentation tanks will be installed; that is, one (1) replacing a fermenter tank which has been converted to a buffer/surge tank and one (1) fermenter tank to facilitate the thorough cleaning of these tanks in a batch process cycle, rather than the

continuous cycle. However, the total volume processed through the fermentation process will not change from that nominated in Project – MP06_0228.

4. **Ethanol Distillery:** To reduce the amount of steam energy consumed by the Ethanol Distillery it is proposed to replace one of the older high pressure distillation columns with three (3) newer improved design low pressure columns. These newer columns will run at a lower steam pressure than the column they will replace. There are various other improved energy efficiency upgrades associated with the peripheral support equipment which is integral these proposed minor modifications.

5. **Boilers:** These distillery modifications are designed to improve energy efficiency by reducing the requirements for steam created from the boilers. Therefore, this reduced steam demand will have the effect of reducing the particulate and gaseous emissions from the boilers.

6. **Overall:** The proposed minor modification to the ethanol plant will not increase production capacity or volume throughput. As presented above, it is designed to improve efficiency of both fermentation process and reduce steam consumption in the distillation process. Furthermore, the fermentation tanks and distillation columns, by their very nature, are sealed, closed loop vessels which are designed to optimise the conversion efficiency in each of the process steps from commencement of fermentation to final ethanol distillation product. Therefore, there will not be any additional emission discharge points associated with this minor upgrade or additional emissions through existing discharge points.

7. **Overview - Emissions:** The proposed minor modification will not increase production throughput and therefore, will not increase the gaseous emission of odour, oxides of nitrogen, volatile organic compounds, such as ethanol, or particulate emissions from the coal fired boilers. In fact, it is likely that there will be an overall reduction in emissions from the plant; in particular, greenhouse gas emissions.

8. **Conclusion - Air Quality Impact Assessment:** Therefore, since these minor modifications are not involved with increasing emissions to atmosphere and are contained within closed loop vessels, it is concluded that the original GHD dispersion modelling and the more recent PAE Holmes modelling (refer to attached) based on these increased throughputs to determine the impact on air quality associated with the Shoalhaven Starches Expansion Project – MP06_0228 will not change.

We trust this summary of the air quality issues associated with the minor modification is satisfactory. Should you, however, require further clarification please call.

Yours Faithfully,

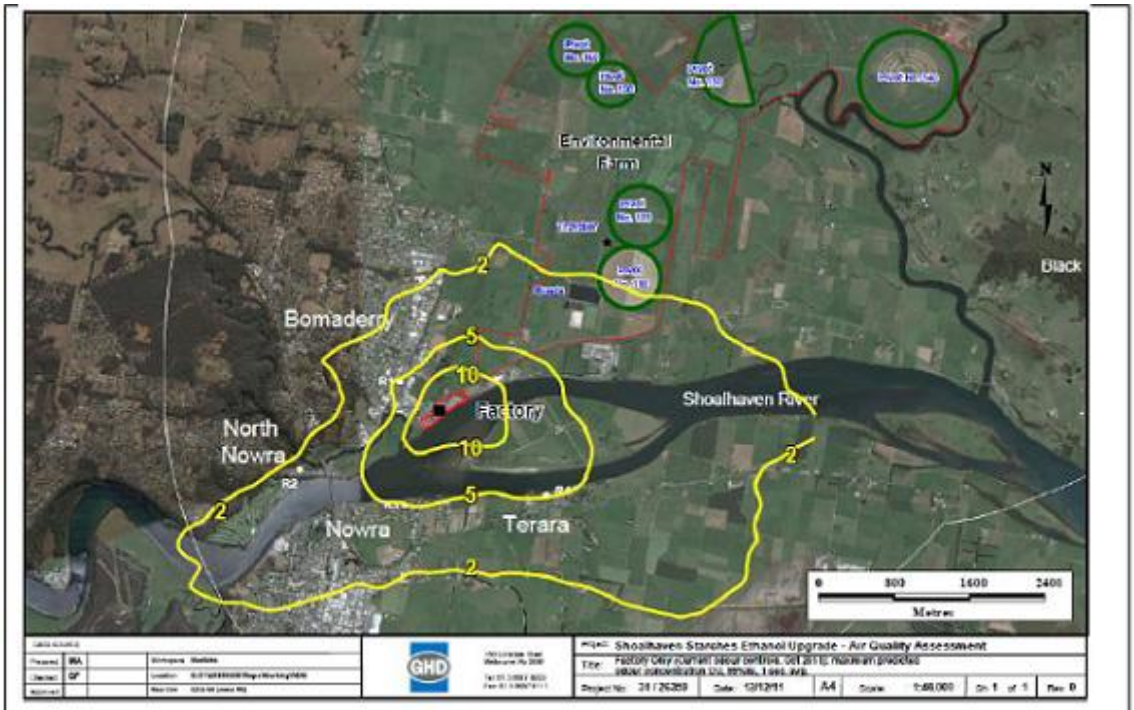
Peter Stephenson
Principal Consultant/Managing Director
STEPHENSON ENVIRONMENTAL MANGEMENT AUSTRALIA

APPENDIX A: SEMA Input Data

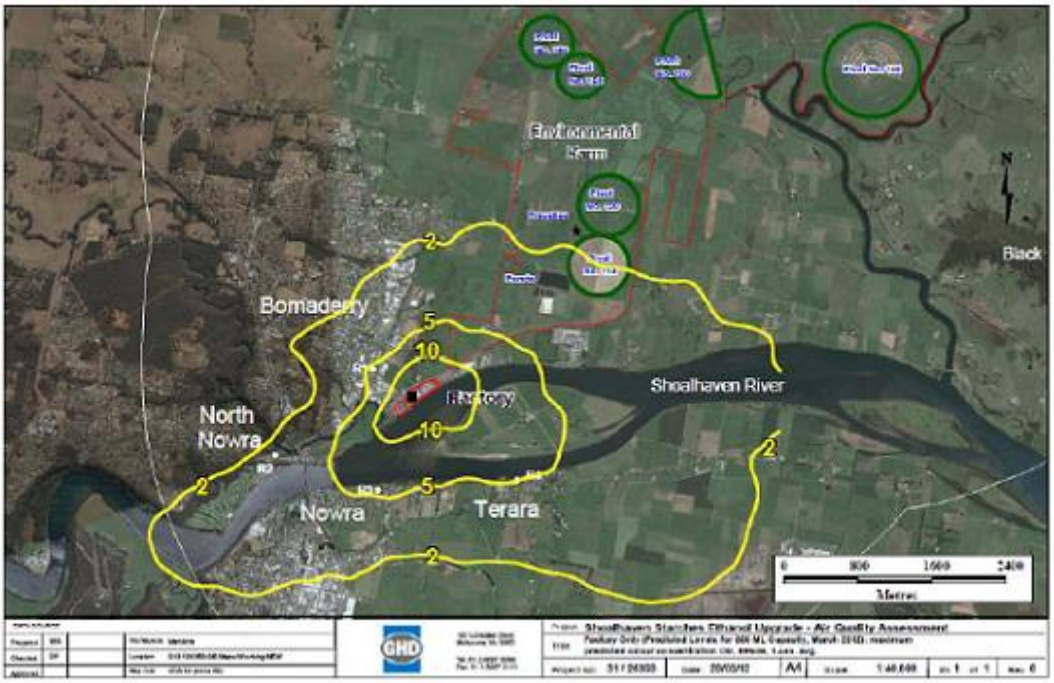
Emission Test Results	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture
Project Number	4995	4995	4995	4995	4995	4995	4995	4995	4995
Project Name	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches
Test Location	**Gluten Dryer No.6**	**Gluten Dryer No.7**	**Starch Dryer No.1**	**Boiler No.4**	**Boiler No.5&6**	**Boiler No.4**	**Ethanol Recovery Scrubber Discharge**	**Fermenter Fill Discharge**	**Stillage Surge Tank Discharge**
Date	21-Feb-12	21-Feb-12	21-Feb-12	21-Feb-12	21-Feb-12	21-Feb-12	21-Feb-12	21-Feb-12	21-Feb-12
	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet
Run	1	1	1	1- With DDG Gases	1	2- No DDG Gases	1	1	1
Method	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22
Sample Start Time (hrs)	10:24	12:53	10:27	11:29	11:22	11:58	12:21	10:00	14:00
Sample Stop Time (hrs)	10:36	13:03	10:39	11:39	11:35	12:08	12:34	10:14	14:11
Inlet/Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (^oC)	69.7	63.1	39.4	105.0	132.0	105.3	27.0	30.2	86.5
Stack Cross-Sectional area (m^2)	2.270	2.297	2.250	0.985	3.142	0.985	0.071	0.071	0.018
Average Stack Gas Velocity (m/s)	22.4	18.9	9.1	5.4	12.2	5.3	10.8	14.7	3.3
Actual Gas Flow Volume (am^3/min)	3,053	2,703	1,228	321	2,295	315	46	62	3
Total Normal Gas Flow Volume (m^3/min)	2,425	2,196	1,072	232	1,544	227	41	56	3
Total Normal Gas Flow Volume (m^3/s)	40.4	36.6	17.9	3.9	25.7	3.8	0.7	0.9	0.0

Total Stack Pressure (kPa)	100.99	92.00	101.20	101.16	101.08	101.16	101.16	101.44	101.20
Moisture Content (% by volume)	3.93	100.00	2.90	19.79	5.39	16.30	2.64	3.91	30.36
Molecular Weight Dry Stack Gas (g/gmole)	28.000	28.000	28.000	28.000	30.076	28.822	28.000	28.000	28.000
Dry Gas Density (kg/m^3)	1.25	1.25	1.25	1.25	1.34	1.29	1.25	1.25	1.25
Oxygen (%)	0.0	0.0	0.0	0.0	8.7	20.6	0.0	0.0	0.0
Analysis	Odour	Odour	Odour	Odour	Odour	Odour	Odour	Odour	Odour
Method	AS4323.3	AS4323.3	AS4323.3	AS4323.3	AS4323.3	AS4323.3	AS4323.3	AS4323.3	AS4323.3
Odour Concentration (As Received) (ou)	311	261	615	569	1743	285	6095	9661	3117
Odour Concentration (Final) (ou)	311	261	615	569	1743	285	6095	9661	3117
Normal MOER (As Received) (ou m^3/s)	12,568	9,553	10,987	2,197	44,851	1,079	4,239	9,045	138
Normal MOER (Final) (ou m^3/s)	12,568	9,553	10,987	2,197	44,851	1,079	4,239	9,045	138
Mass Odour Emission Rate Limit (ou m^3/s)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit

APPENDIX B: **Odour Plots and Results**



Production @ 240 ML/annum



Production @ 300 ML/annum

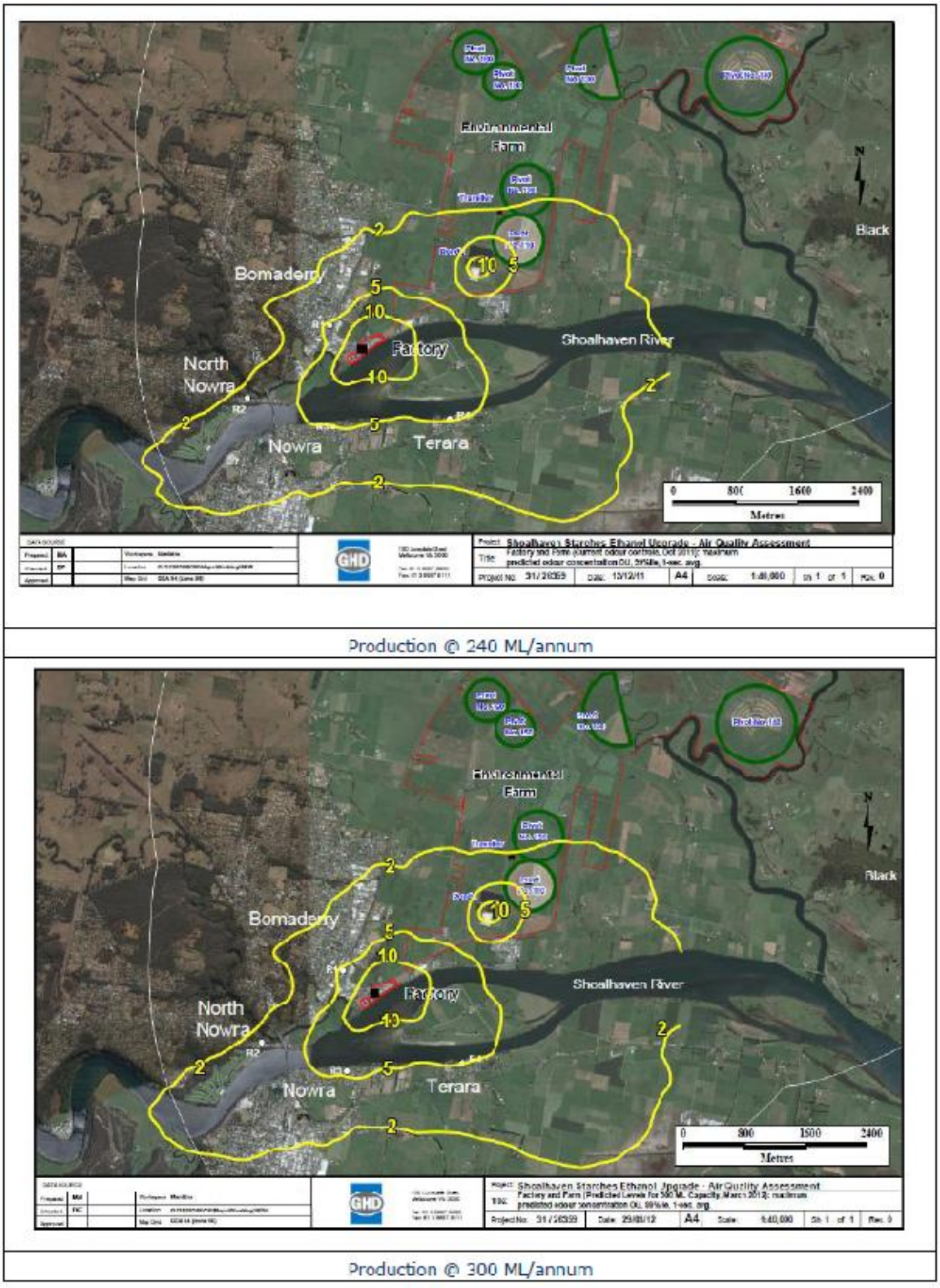


Figure 5.2: Modelling Results for Combined Factory and Farm

Table 4.1: Odour Emission Inventory Changes

Source	Description of Change	New OER (OU.m3/s)	Previous Modelling OER (OU.m3/s)
Vent Condenser Drain	Scaled by 20% for production increase	3,958	3,167
DDG Dryer Building Cooling Towers	Scaled by 20% for production increase	6,833	8,542
Incondensable Gases Vent	Scaled by 20% for production increase	400	500
DME Vent	Decommissioned	N/A	107
Yeast Propagators Tanks 1,2,3	Decommissioned	N/A	5,500
Fermenter Tanks (10,11,12,13,14,15)	Tanks 12, 13, 14. 15 are included. Tank 12 was re-tested (during filling) at 240 ML/annum. All tanks were scaled by 20% for production increase based on Tank 12 result	9,045	518 719
Ethanol Recovery Scrubber Discharge	New source, tested at 240 ML/annum and scaled by 20% for production increase	5,299	N/A
Stillage Surge Tank Discharge	New source, tested at 240 ML/annum and scaled by 20% for production increase	173	N/A
No. 6 Gluten Dryer	New source, tested at 240 ML/annum and scaled by 20% for production increase	12,568	N/A
No. 7 Gluten Dryer	New source, tested at 240 ML/annum and scaled by 20% for production increase	9,553	N/A
No. 1 Starch Dryer	Tested at 240 ML/annum and scaled by 20% for production increase	10,987	6,315
No. 5 Starch Dryer	Not needed for 300 ML/annun	N/A	6,794
Boiler 4 (converted from coal to gas)	Tested at 240 ML/annum under gas firing and scaled by 20% for production increase	2,746	22,889
Boiler 5&6	Tested at 240 ML/annum and scaled by 20% for production increase	58,120	63,075

Table 5.1: Predicted Odour Concentration (OU, 99th Percentile, nose response average)

Scenario Description	Bomaderry (R1)	North Nowra (R2)	Nowra (R3)	Terara (R4)
300 ML/annum				
All Sources	4.7	2.6	5.3	5.1
Factory Only	4.7	2.5	5.2	5.1
240 ML/annum				
All Sources	4.8	2.6	4.9	5.1
Factory Only	4.6	2.5	4.9	5.1
126 ML/annum				
All Sources	4.7	2.3	4.7	5.1
Factory Only	4.6	2.3	4.7	5.1

APPENDIX C: PAE Holmes Report for Operating at 300ML/annum ethanol production

4 April 2012

Mr Brian Hanley
Shoalhaven Starches
Bolong Road
Bomaderry, NSW

ODOUR AUDIT FOR OPERATING AT 300 ML/ANNUM ETHANOL PRODUCTION

1 INTRODUCTION

The Manildra Group operates Shoalhaven Starches at Bolong Road, Bomaderry, processing flour and grain to produce ethanol, starch, glucose, gluten and dried distillery's grain (DDG). Approval was granted by the NSW Department of Planning and Infrastructure (DPI) in 2009 for the staged implementation of increased ethanol production (from 126 ML to 200 ML/annum and from 200 ML to 300 ML/annum).

Prior to submitting an application to increase to 300 ML/annum, Shoalhaven Starches were required to prepare an odour audit while operating at 200 ML/annum and provide an assessment of the likely odour impacts of the proposed increase, based on odour monitoring and modelling.

Shoalhaven Starches recently completed an odour audit while operating at 240 ML/annum. The report concluded that on the basis of odour monitoring and modelling, the existing odour controls (mandatory stage 1 odour controls) are considered effective for the increase to >200 ML/annum.

1.1 Objective

The objective to this report is to determine the additional risk, in terms of odour impact, in increasing production to 300 ML/annum and to identify which (if any) additional odour controls, such as those outlined in Appendix 3 of the project approval, need to be implemented.

The consideration of additional odour controls is based on what is reasonable and feasible having regard to conclusions from the odour audit, industry best practice, ongoing improvements in environmental performance and prevention of offensive odour under section 129 of the Protection of Environment Operations Act.

PAEHolmes

SYDNEY

Suite 203
Level 2, Building D
240 Beecroft Rd
Epping NSW 2121

Ph: + 61 2 9870 0900
Fax: + 61 2 9870 0999

info@paeholmes.com
www.paeholmes.com

BRISBANE

MELBOURNE

ADELAIDE

PERTH

A PEL COMPANY

Queensland Environment Pty Ltd
Trading as PAEHolmes
ABN: 86 127 101 642

2 ASSESSMENT APPROACH

The approach to assessing the potential impact from the increase to 300 ML/annum is as follows:

- Identify all odour sources which have the potential to increase odour emissions when operating at 300 ML/annum. The potential for increased odour emissions was considered for both increases in air flow and in odour concentration.
- Complete odour monitoring for any sources which were not previously sampled at the existing production level.
- Determine the ratio of future/existing production and using this ratio apply a scaling factor to all odour sources which are identified as being scalable to production.
- Based on the scaled odour emissions inventory, predict using dispersion modelling the offsite ground level concentrations (glcs) of odour.
- Compare glc predictions for 300 ML/annum with those made while operating at existing production levels, also having regard to the number of complaints received at existing production.

It is assumed that the increase in odour is proportional to production. However, it should be noted that an increase in production of ethanol does not necessarily result in a linear increase in odour emission from all sources, since the ethanol production process is often distinct from potentially odorous processes elsewhere within the facility. For example:

- The DDG loadout is a batch process and unrelated to increased ethanol production. There will be more DDG produced, however the storage area will not increase and the rate of load out will not increase.
- Odorous flows to the biofilter would not necessarily increase linearly with increased ethanol production. The biofilter is operating at its design performance criteria, and will continue to do so provided it is maintained correctly and specified to deal with any increased flow. Shoalhaven Starches are doubling the size of the biofilter (i.e. 100% increase) which is more than enough redundancy to deal with a 20% increase in production.
- While odorous flows to the boilers may increase, the resultant odour emission rate following destruction may not necessarily have the same linear increase. However, to be conservative we have assumed a linear increase. Also, an additional gas fired boiler has been converted to provide redundancy for additional odorous flows. The additional boiler capacity accounts for a 50% increase, compared with a 20% increase in production.
- The WWTP capacity of 9 ML/day incorporates the additional flow under the proposed ethanol upgrade and the odour control performance of the system should not be affected by an increase in ethanol production.

In summary, for all sources identified as having the potential for increased odour emissions we have assumed a proportional increase relative to the increase in production. In reviewing the emissions inventory, a number of sources were also confirmed as being decommissioned and were removed from the modelling.

3 ODOUR MONITORING

A number of new odour sources, not previously tested were sampled while operating at existing production and used to update the emissions inventory. The results of the monitoring for new sources are presented in **Table 3.1**. The odour monitoring report is provided as **Appendix A**.

There were also some existing sources that have been retested. The No.1 Starch Dryer has a new scrubber and for this reason was retested. The No. 4 Boiler is now gas fired and has therefore been re-tested. All other significant sources had been tested at existing production as part of the previous odour audit (**PAEHolmes, 2012**).

Table 3.1: Odour Monitoring Results

Source	Odour Concentration (OU)	OER (OU.m3/s)
New Sources tested		
No 6 Gluten Dryer	311	12,568
No 7 Gluten Dryer	261	9,553
Ethanol Recovery Scrubber Discharge	6,095	4,239
No 12 Fermenter Fill Discharge	9,661	9,045
Stillage Surge Tank Discharge Vent	3,117	138
Existing Sources (re-tested)		
No 1 Starch Dryer	615	10,987
No.4 Boiler	569	2,197
No. 5&6 Boiler	1,743	46,496

4 ODOUR EMISSIONS INVENTORY

A summary of the changes to the odour emissions inventory are presented in **Table 4.1.** The full revised emissions inventory is shown in **Appendix B.**

The odour emissions rates (OER) for most sources have increased based on the revised monitoring results and the scaling for production, however some sources have been decommissioned and other sources have dropped in OERs (i.e. the boiler stacks).

Table 4.1: Odour Emission Inventory Changes

Source	Description of Change	New OER (OU.m3/s)	Previous Modelling OER (OU.m3/s)
Vent Condenser Drain	Scaled by 20% for production increase	3,958	3,167
DDG Dryer Building Cooling Towers	Scaled by 20% for production increase	6,833	8,542
Incondensable Gases Vent	Scaled by 20% for production increase	400	500
DME Vent	Decommissioned	N/A	107
Yeast Propagators Tanks 1,2,3	Decommissioned	N/A	5,500
Fermenter Tanks (10,11,12,13,14,15)	Tanks 12, 13, 14. 15 are included. Tank 12 was re-tested (during filling) at 240 ML/annum. All tanks were scaled by 20% for production increase based on Tank 12 result	9,045	518 719
Ethanol Recovery Scrubber Discharge	New source, tested at 240 ML/annum and scaled by 20% for production increase	5,299	N/A
Stillage Surge Tank Discharge	New source, tested at 240 ML/annum and scaled by 20% for production increase	173	N/A
No. 6 Gluten Dryer	New source, tested at 240 ML/annum and scaled by 20% for production increase	12,568	N/A
No. 7 Gluten Dryer	New source, tested at 240 ML/annum and scaled by 20% for production increase	9,553	N/A
No. 1 Starch Dryer	Tested at 240 ML/annum and scaled by 20% for production increase	10,987	6,315
No. 5 Starch Dryer	Not needed for 300 ML/annun	N/A	6,794
Boiler 4 (converted from coal to gas)	Tested at 240 ML/annum under gas firing and scaled by 20% for production increase	2,746	22,889
Boiler 5&6	Tested at 240 ML/annum and scaled by 20% for production increase	58,120	63,075

5 MODELLING RESULTS

To determine the effectiveness of existing odour controls while the factory is running at the 300ML/annum, revised dispersion modelling has been conducted based on the monitoring data presented in **Section 3**.

Modelling was conducted using revised odour emissions data derived from the testing results presented in **Section 3**.

The results of the revised modelling are shown in **Table 5.1** and compared to model predictions while operating under previously approved ethanol production rates.

The revised modelling indicates:

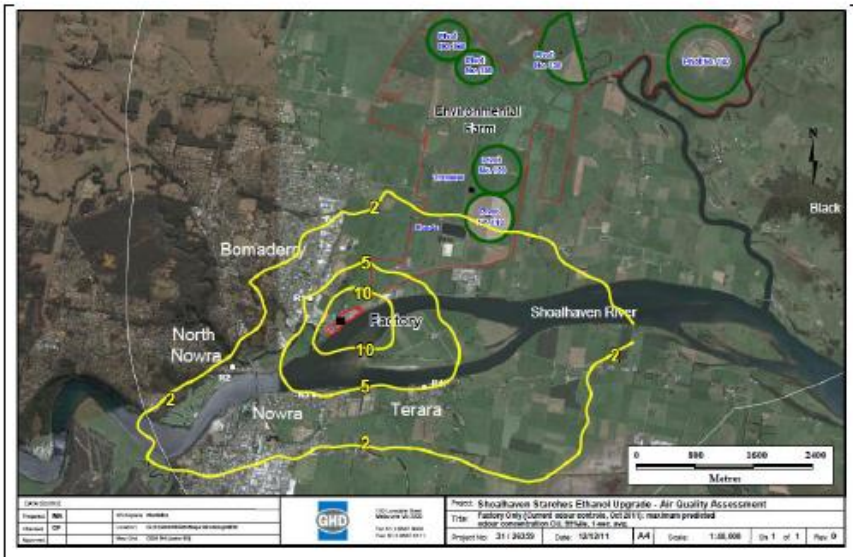
- There is a predicted increase in odour glc for the 300 ML/annum production level at only one receptor location (R3 Nowra). However, the predicted increase is negligible (< 0.3 OU);
- At other receptor locations the predicted odour glc is either the same or less. The reason for the odour glc prediction being less is that some sources were removed from the modelling (as they are now decommissioned) while others had a slightly lower odour emission rate based on the latest round of odour monitoring.

Table 5.1: Predicted Odour Concentration (OU, 99th Percentile, nose response average)

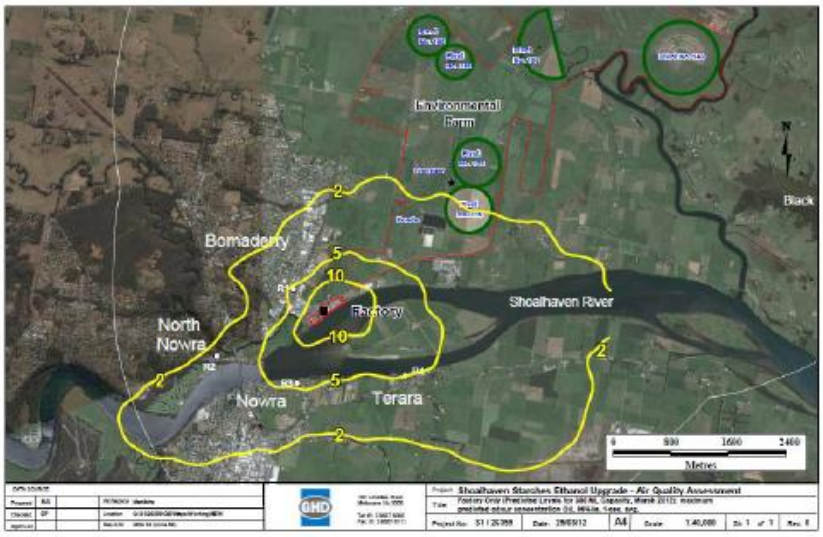
Scenario Description	Bomaderry (R1)	North Nowra (R2)	Nowra (R3)	Terara (R4)
300 ML/annum				
All Sources	4.7	2.6	5.3	5.1
Factory Only	4.7	2.5	5.2	5.1
240 ML/annum				
All Sources	4.8	2.6	4.9	5.1
Factory Only	4.6	2.5	4.9	5.1
126 ML/annum				
All Sources	4.7	2.3	4.7	5.1
Factory Only	4.6	2.3	4.7	5.1

Contour plots for the revised modelling results are shown in **Figure 5.1** and **Figure 5.2** and compared with the modelling results for 240 ML/annum production. The contour plots show the maximum extents of the predicted odour impact, expressed as a 99th percentile, nose response average concentration.

The contour plots indicate that the predicted odour glc has only increased slightly for the 2OU contour but very little difference is noticed at the higher contour levels.

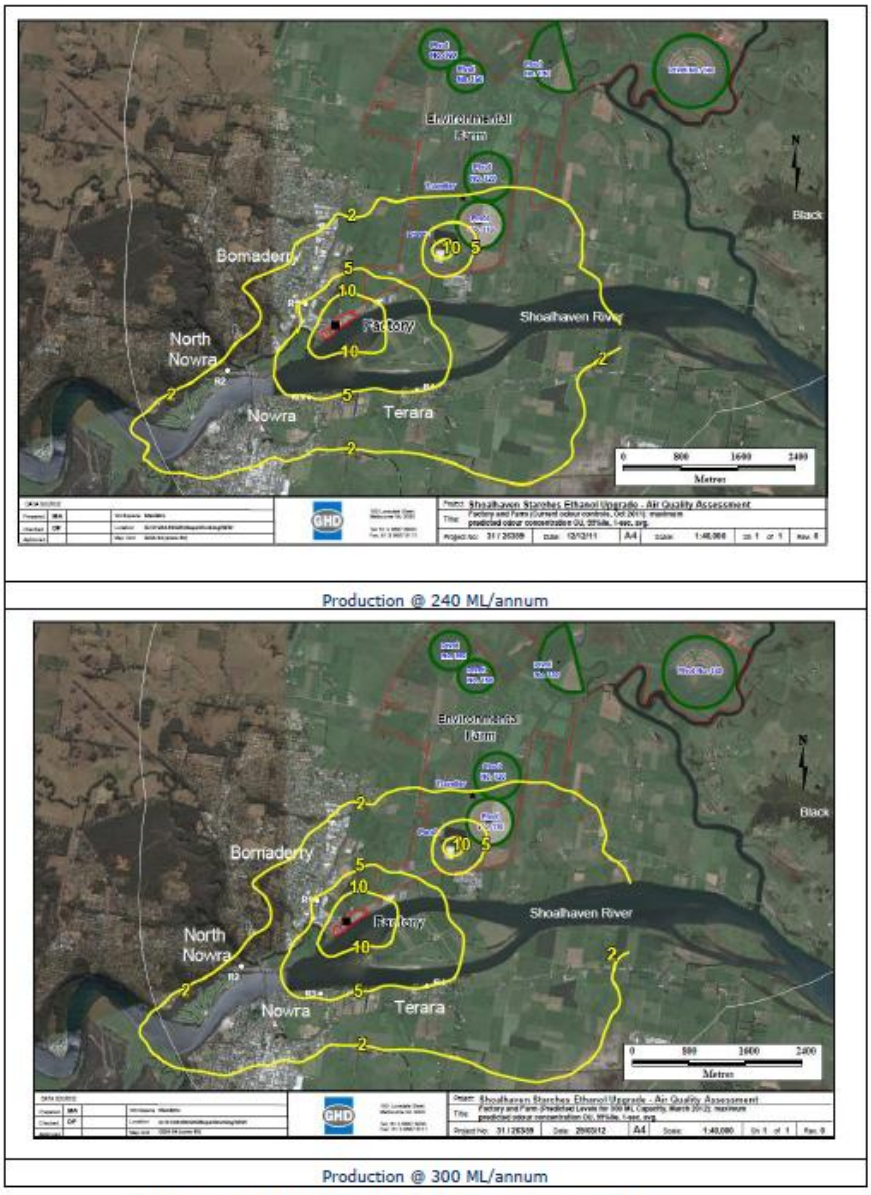


Production @ 240 ML/annum



Production @ 300 ML/annum

Figure 5.1: Modelling Results for Factory Only



Production @ 240 ML/annum

Production @ 300 ML/annum

Figure 5.2: Modelling Results for Combined Factory and Farm

6 ODOUR COMPLAINT DATA

A summary of the odour complaint data for summer periods (October to April) is presented in **Table 6.1** for the previous five years. These summer periods correlate most strongly with odour complaints due to the seasonal changes in wind patterns

Since the increase in production to 240 ML/annum in June 2011, two odour complaints have been received. This is less than the 8 complaints received between October 2010 and April 2011 under a lower production level and significantly less than the number of complaints received prior to the implementation of mandatory odour controls.

The declining trend in odour complaints is indicative of the effectiveness of the mandatory odour controls and the complaints data received to date indicates that the implementation of the mandatory odour controls are proving effective for the increase to 240 ML/annum.

Table 6.1: Summary of Complaints Data for Summer Months (October – April)

Year	Complaints received
2007 / 2008 (@ 126 ML/annum)	120
2008 / 2009 (@ 126 ML/annum)	100
2009/ 2010 (@ 126 ML/annum)	45
2010 / 2011 (@ 126 ML/annum)	8
2011 / 2012 (@ 240 ML/annum) [1]	2

Note: [1] as of April 2012

7 CONCLUSION

Prior to submitting an application to increase to 300 ML/annum, Shoalhaven Starches prepared an odour audit while operating at 240 ML/annum and provided an assessment of the likely odour impacts of the proposed increase.

To assess the likely odour impacts of a 300 ML/annum production scenario, the ratio of future to existing production was determined and used as a scaling factor for all odour sources identified as being scalable to production. Accordingly, these odour sources were modelled with a 20% higher odour emission rate.

Based on the scaled odour emissions inventory, dispersion modelling was used to predict ground level concentrations (glcs) of odour for the 300 ML/annum production scenario. The predicted increase in odour glc was minimal. Results predicted at selected residential receptors showed an immeasurable increase in odour glc, while at some areas the odour decreased. This is because some sources were removed from the modelling (as they are now decommissioned) while others had a lower odour emission rate based on the latest round of odour monitoring.

The objective to this report is to determine the additional risk, in terms of odour impact, in increasing production to 300 ML/annum and to identify which (if any) additional odour controls, such as those outlined in Appendix 3 of the project approval, need to be implemented.

Based on the results of the modelling, there appears to be immeasurable additional odour risk, in increasing production to 300 ML/annum. However, the assumption that odour emissions can be scaled according to the production increase may need some ground truthing while operating at 300 ML/annum.

Shoalhaven Starches have implemented the following additional odour control measures:

- Boiler 4 has been converted from coal to gas fired and has been brought online to treat DDG gases.
- The size and the capacity of biofilter is being be doubled (due to completion June 2012) to provide additional treatment for odorous flows.

8 REFERENCES

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PAEHolmes (2012) "Shoalhaven Starches - Independent Odour Audit - Operating at <200 ML/annum", 12 January 2012.

TOU (2010) "Shoalhaven Starches Expansion Project – Odour Management Plan", The Odour Unit, May 2010.

TOU (2011) "DDG Biofilter Assessment", The Odour Unit, 11 February 2010.

APPENDIX A

Odour Monitoring Report

Stephenson
Environmental Management Australia

ODOUR EMISSION SURVEY – 300ML/A - STACKS

SHOALHAVEN STARCHES PTY LTD

BOMADERRY, NSW

PROJECT NO.:	**4995S/S21215/12**
DATE OF SURVEY:	**21 FEBRUARY 2012**
DATE OF DRAFT ISSUE:	**23 FEBRUARY 2012**
DATE OF FINAL ISSUE:	**9 MARCH 2012**

P W STEPHENSON

A NAGHIZADEH

P CRABBE

Stephenson
Environmental Management Australia

Peter W Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

Newington Business Park
Unit 7/2 Holker Street
Newington NSW 2127 Australia
Tel: (02) 9737 9991
Fax: (02) 9737 9993
E-Mail: info@stephensonenv.com.au

ODOUR EMISSION SURVEY – 300 ML/A - STACKS

SHOALHAVEN STARCHES PTY LTD

BOMADERRY, NSW

PROJECT NO.: 4995S/S21215/12

DATE OF SURVEY: 21 FEBRUARY 2012

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P W STEPHENSON

A NAGHIZADEH

P CRABBE

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1 INTRODUCTION

Stephenson Environmental Management Australia (SEMA) was requested by Shoalhaven Starches Pty Limited to conduct an odour emission survey on a number of additional point sources (stacks) associated with the proposed 300 million litre per annum upgrade at their starch and ethanol plant in Bomaderry, New South Wales (NSW).

The objective of the survey is to measure odour emissions sources for the proposed increase in production to 300 million litres per year.

2 PRODUCTION CONDITIONS

Shoalhaven Starches personnel considered the factory and ethanol distillery were operating under typical conditions on the dayof testing.

3 RESULTS AND CONCLUSIONS

SEMA completed the odour sampling and analysis at Shoalhaven Starches manufacturing facility for the proposed 300 million litres per year production step. The odour analysis was performed by Odour Research Laboratories Australia (ORLA), ORLA report numbers 4995S/ORLA/02.

SEMA and ORLA are NATA accredited facilities to ISO 17025-2005 including odour sampling and analysis, NATA accreditation number 15043.

The results of the emission tests from the point sources are presented in detail in Tables A-1 to A-3 of Appendix A.

Tables 4-1 summarise the odour concentration for all point sources measured as part of this survey.

Appendix B presents the Certificates of Analysis, while Appendix C contains details on the most recent calibration of each instrument used to take measurements.

TABLE 3-1 EMISSION CONCENTRATIONS TEST RESULTS – ADDITIONAL POINT SOURCES – FEBRUARY 2012

Description	Odour Concentration (ou)
No 6 Gluten Dryer	311
No 7 Gluten Dryer	261
No 1 Starch Dryer	615
No 4 Boiler (with DDG gases in)	569
No 5&6 Boiler (with DDG gases in)	1,743
No 4 Boiler (without DDG gases in)	285
Ethanol Recovery Scrubber Discharge	6,095
No 12 Fermenter Fill Discharge	9,661
Stillage Surge Tank Discharge Vent	3,117

4 TEST METHODS

4.1 ODOUR MEASUREMENT/DYNAMIC OLFACTOMETRY

(AS 4323.3 & AS 4323.4 and OM-7 and OM-8)

Samples were collected in 30L Nalophane sampling bags which are enclosed in airtight plastic containers.

Odorous gas for analysis was drawn through a Teflon (PTFE) sample probe. The gas then passes through a Teflon (PTFE) tube connected to the Nalophane sampling bag. The sampling pump is connected to the airtight plastic container to provide a sample gas flow-rate of approximately 0.5 – 1.5 litres per minute. After the required volume has been sampled, the pump is stopped and the bag sealed with a stainless steel valve. Two samples were collected from each site.

Using a triangular forced choice olfactometer, the Nalophane bag of odour sample was dynamically diluted to various concentrations with dry odour free air.

The diluted sample was then presented to a panel of screened panellists as one of these airflows. The panellists then recorded if they could detect any odour and from which flow. The other two flows were discharging odour free air.

The odour is always presented to the panellists in ascending concentration; that is, from lower to higher concentration. The panellists are required at each dilution level to give a response as to what they are smelling from the flows (forced choice methodology). The response options for the panellists are:

'Guess'	Unable to determine which air flow contains the diluted odours
'Inkle'	Thinks that one of the flows could be different from the other two flows
'Detect' or 'Certain'	Is confident that one of the airflows smells different from the other two flows. Not necessarily able to say what the smell is.
'Recognise'	Thinks that one of the flows could be different from the other two flows and is able to: ▪ Assign a 'hedonic tone' (pleasantness scale number) to the odour ranging from -10 to 10 and/or ▪ Able to assign a character to the colour, as in 'it smells like …' *Note: that the Recognise level concentration and Hedonic Tone and Odour descriptors are obtained with the diluted odour, panellists are not exposed to the full strength odour.*

The percentage panel response and dilution levels used were then entered into a computer programme to determine the 50% panel response. This dilution level corresponds to the odour concentration of the sample.

Sampling and dilution lines are constructed from teflon, stainless or glass to prevent contamination of the sample.

The sampling and the dilution procedures used were in accordance with OEH NSW Method OM-7 and OM-8, which are based on Standards Association of Australia, AS4323.3.

4.1.1 ODOUR PANEL SELECTION

Odour panellists must meet certain criteria to qualify as and remain panellists. Their average sensitivity to n-Butanol must be between 20 and 80 parts per billion (ppb) and their variability in response to n-Butanol must be within a certain range.

Panellists are tested against n-Butanol before every panel session to ensure they are in compliance.

Panellists should not suffer from respiratory complaints, nor should they eat or smoke or drink anything but water during the half hour preceding or during the test period and their person and clothing should be odour free and have not been exposed to an odorous environment before testing.

4.1.2 ODOUR TERMINOLOGY

The odour level is expressed in odour units and for mixed odours is analogous to concentration expressed in parts per billion. The odour detection level is defined as the ratio of *the volume that a sample of odorous gas would occupy when diluted to the threshold of detection of that odour* to *the volume of the sample*. In simpler terms, the ratio indicated the number of dilutions necessary to reduce the odour to its threshold of detection or odour detection threshold. This ratio is expressed in odour units or number of dilutions to detection threshold. For example, a value of 2,000 odour units would mean the volume of the initial sample of odorous gas would need to be diluted 2,000 times before the odour would just be detectable to the average human nose, that is, at the odour detection threshold.

4.2 EXHAUST GAS VELOCITY

(OEH NSW TM-2 and USEPA Method 12)

Velocity profiles were obtained across the stack utilising an Airflow Developments Ltd. S-type pitot tube and inclined manometer.

4.3 EXHAUST GAS TEMPERATURE

(OEH NSW TM- 2, 3 & 4 and USEPA Methods 2, 3 & 4)

The exhaust gas temperature was measured using a Digital thermometer (0-1200°C) connected to a chromel/alumel (K-type) thermocouple probe.

4.4 OXYGEN (O_2)

(OEH NSW TM-25 and USEPA Method 3A)

O_2 was analysed by a Testo 350 analyser.

4.5 MOISTURE

(OEH NSW TM-22 and USEPA Method 4)

Moisture from the stack was determined in accordance with OEH NSW TM-22 and USEPA Method 4. In particular, M4 Section 2.2.1 which nominates a moisture approximation method used to enable calculation of isokinetic sampling rates or where isokinetic sampling are not required such as odour sampling.

4.6 ACCURACY (VELOCITY, MOISTURE AND OXYGEN)

All results are quoted on a dry basis. SEMA has adopted the following (Table 6-1) uncertainties for various stack testing methods.

TABLE 4-1 ESTIMATION OF MEASUREMENT UNCERTAINTY

Pollutant	Methods	Uncertainty
Moisture	AS4323.2, TM-22, USEPA 4	25%
Odour	AS4323.3, AS4323.4	3 times
Oxygen and Carbon Dioxide	TM-24, TM-25, USEPA 3A	1% actual
Velocity	AS4323.1, TM-2, USEPA 2A & 2C	5%

Key:

Unless otherwise indicated the uncertainties quoted have been determined @ 95% level of Confidence level (i.e. by multiplying the repeatability standard deviation by a co-efficient equal to 1.96) (Source - Measurement Uncertainty)

Sources: *Measurement Uncertainty – implications for the enforcement of emission limits by Maciek Lewandowski (Environment Agency) & Michael Woodfield (AEAT) UK*

Technical Guidance Note (Monitoring) M2 Monitoring of stack emissions to air Environment Agency Version 3.1 June 2005.

APPENDIX A – EMISSION TEST RESULTS

Glossary:

%	=	percent
°C	=	Degrees Celsius
am³/min	=	cubic metre of gas at actual conditions per minute
Normal Volume (m³)	=	cubic metre at 0°C and 760 mm pressure and 1 atmosphere
am³	=	cubic metre of gas at actual conditions
g/g mole	=	grams per gram mole
g/s	=	grams per second
hrs	=	hours
kg/m³	=	kilograms per cubic metre
kPa	=	kilo Pascals
m²	=	square metre
m/s	=	metre per second
m³/sec	=	cubic metre per second at 0°C and 1 atmosphere
mg	=	milligrams
mg/ m³	=	milligrams per cubic metre at 0°C and 1 atmosphere
O_2	=	Oxygen
NA	=	Not accessible – sample port not available

Abbreviations for names of SEMA staff who completed either/and/or Sampling, Analysis and Checking

PCr	=	Peter Crabbe
AN	=	Ali Naghizadeh
AP	=	Alok Pradhan
JW	=	Jay Weber
PWS	=	Peter W Stephenson

TABLE A - 1 EMISSION TEST RESULTS –GLUTEN DRYERS AND STARCH DRYER #1 – ODOUR AND FLOW

Emission Test Results	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture
Project Number	4995	4995	4995
Project Name	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches
Test Location	**Gluten Dryer No.6**	**Gluten Dryer No.7**	**Starch Dryer No.1**
Date	21-Feb-12	21-Feb-12	21-Feb-12
	Wet	Wet	Wet
Run	1	1	1
Method	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22
Sample Start Time (hrs)	10:24	12:53	10:27
Sample Stop Time (hrs)	10:36	13:03	10:39
Inlet/Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (oC)	69.7	63.1	39.4
Stack Cross-Sectional area (m2)	2.270	2.297	2.250
Average Stack Gas Velocity (m/s)	22.4	18.9	9.1
Actual Gas Flow Volume (am3/min)	3,053	2,703	1,228
Total Normal Gas Flow Volume (m3/min)	2,425	2,196	1,072
Total Normal Gas Flow Volume (m3/s)	40.4	36.6	17.9
Total Stack Pressure (kPa)	100.99	101.10	101.20
Moisture Content (% by volume)	3.9	3.8	2.9
Analysis	Odour	Odour	Odour
Method	AS4323.3	AS4323.3	AS4323.3
ORLA Number	3259	3260	3261
SEMA Number	721004	721005	721006
Odour Concentration (As Received) (ou)	311	261	615
Odour Concentration (Final) (ou)	311	261	615
Normal MOER (As Received) (ou m3/s)	12,568	9,553	10,987
Normal MOER (Final) (ou m3/s)	12,568	9,553	10,987
Mass Odour Emission Rate Limit (ou m3/s)	No Limit	No Limit	No Limit
Sample Storage Period	2 days	2 days	2 days
Calculations entered by	AN	AN	AN
Calculations checked by	PWS	PWS	PWS

TABLE A - 2 EMISSION TEST RESULTS – BOILER 4 AND BOILER 5&6 COMBINED – ODOUR AND FLOW

Emission Test Results	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture
Project Number	4995	4995	4995
Project Name	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches
Test Location	**Boiler No.4**	**Boiler No.4**	**Boiler No.5&6**
Date	21-Feb-12	21-Feb-12	21-Feb-12
Run	Wet 1- With DDG Gases	Wet 2- No DDG Gases	Wet 1
Method	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22
Sample Start Time (hrs)	11:29	11:58	11:22
Sample Stop Time (hrs)	11:39	12:08	11:35
Inlet/Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (oC)	105.0	105.3	132.0
Stack Cross-Sectional area (m2)	0.985	0.985	3.142
Average Stack Gas Velocity (m/s)	5.4	5.3	12.6
Actual Gas Flow Volume (am3/min)	321	315	2,380
Total Normal Gas Flow Volume (m3/min)	232	227	1,601
Total Normal Gas Flow Volume (m3/s)	3.9	3.8	26.7
Total Stack Pressure (kPa)	101.16	101.16	101.08
Moisture Content (% by volume)	4.2	4.2	5.4
Analysis	Odour	Odour	Odour
Method	AS4323.3	AS4323.3	AS4323.3
ORLA Number	3262	3264	3263
SEMA Number	721007	721009	721008
Odour Concentration (As Received) (ou)	569	285	1743
Odour Concentration (Final) (ou)	569	285	1743
Normal MOER (As Received) (ou m3/s)	2,197	1,079	46,496
Normal MOER (Final) (ou m3/s)	2,197	1,079	46,496
Mass Odour Emission Rate Limit (ou m3/s)	No Limit	No Limit	No Limit
Sample Storage Period	2 days	2 days	2 days
Calculations entered by	AN	AN	AN
Calculations checked by	PWS	PWS	PWS

TABLE A - 3 EMISSION TEST RESULTS – ETHANOL RECOVERY SCRUBBER, FERMENTER FILL AND STILLAGE SURGE TANK

Emission Test Results	Velocity & Flow / Moisture	Velocity & Flow / Moisture	Velocity & Flow / Moisture
Project Number	4995	4995	4995
Project Name	Shoalhaven Starches	Shoalhaven Starches	Shoalhaven Starches
Test Location	**Ethanol Recovery Scrubber Discharge**	**Fermenter Fill Discharge**	**Stillage Surge Tank Discharge**
Date	21-Feb-12	21-Feb-12	21-Feb-12
	Wet	Wet	Wet
Run	1	1	1
Method	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22	TM-1 & TM-2 & TM-22
Sample Start Time (hrs)	12:21	10:00	14:00
Sample Stop Time (hrs)	12:34	10:14	14:11
Inlet/Exhaust	Exhaust	Exhaust	Exhaust
Stack Temperature (oC)	27.0	30.2	86.5
Stack Cross-Sectional area (m2)	0.071	0.071	0.018
Average Stack Gas Velocity (m/s)	10.8	14.7	3.3
Actual Gas Flow Volume (am3/min)	46	62	3
Total Normal Gas Flow Volume (m3/min)	41	56	3
Total Normal Gas Flow Volume (m3/s)	0.7	0.9	0.0
Total Stack Pressure (kPa)	101.16	101.44	101.20
Moisture Content (% by volume)	2.6	3.9	30.4
Analysis	Odour	Odour	Odour
Method	AS4323.3	AS4323.3	AS4323.3
ORLA Number	3265	3266	3267
SEMA Number	721010	721011	721012
Odour Concentration (As Received) (ou)	6095	9661	3117
Odour Concentration (Final) (ou)	6095	9661	3117
Normal MOER (As Received) (ou m3/s)	4,239	9,045	138
Normal MOER (Final) (ou m3/s)	4,239	9,045	138
Mass Odour Emission Rate Limit (ou m3/s)	No Limit	No Limit	No Limit
Sample Storage Period	2 days	2 days	2 days
Calculations entered by	AN	AN	AN
Calculations checked by	PWS	PWS	PWS

APPENDIX B – CERTIFICATES OF ANALYSIS

Odour Research Laboratories Australia

A Division of Peter W. Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

Newington Business Park
Unit 7/2 Holker Street
Newington NSW 2127 Australia
Tel: (02) 9737 9991
Fax: (02) 9737 9993
E-Mail: pstephenson@orla.com.au

Olfactometry Test Report

The measurement was commissioned by SEMA on behalf of:

Client	Organisation:	Shoalhaven Starches
	Address:	Bolong Road, Bomaderry NSW 2541
	Contact:	Scott Foggo
	Sampling Site:	Gluten Dryer #6, Gluten Dryer #7, Starch Dryer #1, Boiler #4 (with DDG gases), Boiler 5&6 (with DDG gases), Boiler #4 (no DDG gases), Ethanol Recovery Scrubber, Fermenter Fill Discharge, Stillage Surge Tank
	Telephone:	4423 8280
	Facsimile:	4421 0798
	Email:	Scott.foggo@manildra.com.au
Project	ORLA Report Number:	4995/ORLA/02
	Project Manager:	Peter Stephenson
	Testing operator:	Ali Naghizadeh
	ORLA Sample number(s):	3259 to 3267 inclusive
	SEMA Sample number(s):	721004 to 721012 inclusive
Order	Analysis Requested:	Odour Analysis
	Order requested by:	SEMA on behalf of Shoalhaven Starches
	Date of order:	22 February 2012
	Order number:	3454
	Telephone:	02 9737 9991
	Signed by:	Ali Naghizadeh
	Order accepted by:	Ali Naghizadeh

ODOUR RESEARCH LABORATORIES AUSTRALIA – ODOUR CONCENTRATION MEASUREMENTS RESULTS 4995/ORLA/02

Investigated Item	Odour concentration in odour units 'ou' determined by Sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Analysis Method	The samples were analysed in accordance with AS/NZS4323.3:2001.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification) sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for n-butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Instrument Used	The Olfactometer used during this testing session was: AC'SCENT International Olfactometer
Measuring Range	The measuring range of the AC'SCENT International olfactometer is $13 \leq \chi \leq 61{,}660$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between ± 3°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.05$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $r = 0.0201$ (May 2011) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.20$ in accordance with the Australian Standard AS/NZS4323.3:2001. AC'SCENT International Olfactometer: $A = 0.108$ (May 2011) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the AC'SCENT International Olfactometer has been determined to be 13 ou
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored every session to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

23 February 2012

Peter Stephenson
Managing Director

Odour Research Laboratories Australia

Odour Olfactometry Results – 4995/ORLA/02

Sample Location	Sample ID No.	Sampling Date & Time	ORLA Sample No.	Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration (ou) [1]	Sample Odour Concentration (ou) [2]	Odour Character & Hedonic Tone [^] [*]
Sample ID: Gluten #6	721004	21/2/2012 10:24-10:36	3259	22/2/2012 09:40-10:05	4	8	Nil	311	311	Decomposing corn, hessian, dirt, vegetable odour, cooking cauliflower, cereal (-0.8)[^]
Sample ID: Gluten #7	721005	21/2/2012 12:53-13:03	3260	22/2/2012 10:13-10:35	4	8	Nil	261	261	Cereal, musty, hessian, vegetable odour, cooking cauliflower, off food in fridge, sulphur (-1.8)[^]
Sample ID: Starch #1	721006	21/2/2012 10:27-10:39	3261	22/2/2012 10:40-11:05	4	8	Nil	615	615	Sour grapes, sweet (like 'yoplait'), timber odour sawn or lightly stained (-1.5)[^]
Sample ID: Boiler 4 (with DDG)	721007	21/2/2012 11:29-11:39	3262	22/2/2012 11:10-11:35	4	8	Nil	569	569	Balsamic vinegar, sweet, gassy, coal, faint cooking gas odour, vinegar (-2.0)[^]
Sample ID: Boiler 5 & 6 (with DDG)	721008	21/2/2012 11:22-11:35	3263	22/2/2012 11:42-12:08	4	8	Nil	1,743	1,743	Sharp coal odour, piercing, chlorine, ammonia, cooking gas, burning cloves (-2.3)[^]

Odour Research Laboratories Australia

Odour Olfactometry Results – 4995/ORLA/02

Sample Location	Sample ID No.	Sampling Date & Time	ORLA Sample No.	Analysis Date & Time (Completed)	Panel Size	Valid ITEs	Sample Pre-Dilution	Sample Odour Concentration (ou) [1]	Sample Odour Concentration (ou) [2]	Odour Character & Hedonic Tone[^,+]
Sample ID: Boiler 4 (no DDG)	721009	21/2/2012 11:58-12:08	3264	22/2/2012 12:10-12:35	4	8	Nil	285	285	Sharp coal odour, septic, too faint to describe (0.5)[^]
Sample ID: Ethanol Recovery Scrubber	721010	21/2/2012 12:21-12:34	3265	22/2/2012 13:30-13:55	4	8	Nil	6,095	6,095	Esters, sweet sickly 'yoplait', offensive caramel odour, acidic fruit, piercing, faint varnish/sealer (-0.0)[^]
Sample ID: Fermenter 12 Fill Discharge	721011	21/2/2012 10:00-10:14	3266	22/2/2012 14:00-14:25	4	8	Nil	9,661	9,661	Acidic sweet grain, piercing, caramel, musty, plastic, styrene, faint varnish/sealer (-2.3)[^]
Sample ID: Stillage Surge Tank	721012	21/2/2012 14:00-14:11	3267	22/2/2012 14:30-15:00	4	8	Nil	3,117	3,117	Yeast with rotten egg overtone, roasted nut odour, disgusting biscuits, rancid food, vinegar (-2.5)[^]

Odour Research Laboratories Australia

Odour Panel Calibration Results – 4995/ORLA/02

Reference Odorant	ORLA Sample No.	Concentration of Reference Gas (ppm)	Reference Gas Measured Concentration (ou)	Panel Average Measured Concentration (ppb) [3]	Does this panel calibration measurement comply with AS/NZS4323.3:P2001 (Yes/No) [4]
n-butanol	3258	50.2	1144	43.9	Yes

Comments: All samples were collected by Stephenson Environmental Management Australia and analyses by Odour Research Laboratories Australia at their Sydney Laboratory.

Notes from Odour Olfactometry Results:

[1] Sample Odour Concentration: as received in the bag

[2] Sample Odour Concentration: allowing for pre-dilution

[3] Panel Average Measured Concentration: indicates the sensitivity of the panel for the session completed

[4] Target Range for reference gas n-butanol is $20 \leq \chi \leq 80$ ppb and compliance with AS/NZ4323.3:2001 is based on the individuals rolling average and not on the panel average measured concentration. Panellist Rolling Average: : PR = 43.2, PP = 37.8, TL = 54.8, DS = 39.4

^ denotes the Average Hedonic Tone: describes the pleasantness of the odour being presented where (+5) represents Very Pleasant, (0) represents Neutral and (-5) represents Very Unpleasant and has been derived from the panellist responses at the recognition threshold.

+ This value is not part of our NATA Scope of Accreditation and AS4323.3

APPENDIX C – DETAILS ON INSTRUMENT CALIBRATION

TABLE C - 1 INSTRUMENT CALIBRATION DETAILS

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
881	Digital Manometer	24 / 6 / 2011	24 / 6 / 2012
880	Digital Manometer	24 / 6 / 2011	24 / 6 / 2012
594	Pitot Head	26 / 7 / 2011	26 / 7 / 2012 Visually inspected On-Site before use
726	Pitot Head	26 / 7 / 2011	26 / 7 / 2012 Visually inspected On-Site before use
857	Digital Temperature Reader	28 / 11 / 2011	28 / 5 / 2012
820	Digital Temperature Reader	28 / 11 / 2011	28 / 5 / 2012
864	Thermocouple	14 / 9 / 2011	14 / 3 / 2012
768	Thermocouple	19 / 12 / 2011	19 / 6 / 2012
771	Thermocouple	19 / 12 / 2011	19 / 6 / 2012
769	Thermocouple	19 / 12 / 2011	19 / 6 / 2012
BOM	Nowra Weather Observations	--	--
677, 678, 753, 832	Sampling Pump	23 / 6 / 2011	23 / 6 / 2012
761	Buck Flow Calibrator	12 / 8 / 2008	12 / 8 / 2012

APPENDIX B

Odour Emissions Inventory

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Src grp	No.	Plant	existing or proposed	Section	Unit	Model Reference	OER per unit (OU/m3/s)	No. units	Total OER (OU/m3/s) BEFORE CONTROL	% reduction	Total OER (OU/m3/s) AFTER CONTROL yellow = TBA - need clean trial results, green = wet disp, pink = to DDG biofilter @ stage 1 , blue = biofilter @ stage 2, red = to boiler	Peak OER purple: source divided into sub-sources	Stack (m)	Temp (K) orange value taken from ETC - check SEMA rpt	V (m/s) (measured)	V (m/s) (model input)	Stack diameter (m)	300 ML comments
G	24	DDG	existing	Liquids line	vent condensor drain	DDG25	3,958	1	3,958	0%	3,958	9,104	0.1	300	0.3	0.3	0.3	Scalable to production
G	11	DDG	existing	Loadout	DDG tent storage area	DDG26	12,862	1	12,862	85%	1,929	4,437	volume source - see attached sheet					Non-Scalable to production (more DDG produced but storage area doesn't increase)
G	16	DDG	existing	Loadout	DDG product storage sheds	DDG24	6,820	1	6,820	85%	1,023	2,353	volume source - see attached sheet					Non-Scalable to production (more DDG produced but storage area doesn't increase)
F	14	DDG	existing	Solids line	DDG dryer baghouse (palmer cooler)	DDG16	0	1	0	0%	0	0	16.0	335.0		16.0	0.7	Scalable to production. Directed to boilers so emission rate not scaled.
-	38	DDG	existing	Liquids line	Feeds dryer #3 - baghouses	DDG18	867	1	867	0%	867	1,993	19.0	330.0		0.1	1.0	Non-Scalable to production. Blowers that transfer DDG to shed.
G	40	DDG	existing	Liquids line	light phase recovery tank	DDG19	147	1	147	0%	147	339	11.0	362	3.3	3.3	0.1	Non-Scalable to production
E	4	DDG	existing	Dryer building	Cooling towers	DDG46	85,417	1	85,417	90%	8,542	19,646	10.0	302	7.4	7.4	4.5	Scalable to production. Dryers run harder.
G	42	Distillery	existing	Stage 3	Incondensible gases vent	D6	500	1	500	0%	500	1,150	13.0	309	0.9	0.6	0.2	Scalable to production.
G	31	Distillery	existing	Stage 2	Molecular Sieve - Vacuum drum	D2	1,350	1	1,350	0%	1,350	3,105	10.0	307	13.0	13.0	0.1	Non-Scalable to production
G	52	Distillery	existing	DMS	DMS vent	D12	0	1	0	0%	0	0	36.0	250		1.6	0.1	Source Decommissioned. Remove from model.
G	50	Ethanol	existing	Hammer mill	Grain silo - baghouse	E1	183	1	183	0%	183	422	23.0	304	6.5	0.1	0.4	Non-Scalable to production
D	7	Ethanol	existing	Fermentation	Yeast propagators - tanks 4 & 5	E15Y4	14,167	2	28,333	0%	28,333	32,583	17.0	302	3.2	3.2	0.4	Non-Scalable to production
D	7	Ethanol	existing	Fermentation	Yeast propagators - tanks 4 & 5	E15Y5	14,167	2	28,333	0%	28,333	32,583	17.0	302	3.2	3.2	0.4	Non-Scalable to production
G	17	Ethanol	existing	Fermentation	Grain retention - tank 2 (now located in adjacent tank)	E8	6,500	1	6,500	50%	3,250	7,475	1.0	20	18.0	0.1	0.2	Non-Scalable to production
D	18	Ethanol	existing	Fermentation	Yeast propagators- tanks 1, 2 & 3	E14A	0	1	0	0%	0	0	17.0	306	0.8	0.8	0.5	Source Decommissioned. Remove from model.
D	18	Ethanol	existing	Fermentation	Yeast propagators- tanks 1, 2 & 3	E14B	0	1	0	0%	0	0	17.0	306	0.8	0.8	0.5	Source Decommissioned. Remove from model.
D	18	Ethanol	existing	Fermentation	Yeast propagators- tanks 1, 2 & 3	E14C	0	1	0	0%	0	0	17.0	306	0.8	0.8	0.5	Source Decommissioned. Remove from model.
G	34	Ethanol	existing	Fermentation	Jet cooker 1 - retention tank	E13	1,067	1	1,067	0%	1,067	2,453	10.0	362	1.1	0.1	0.2	Non-Scalable to production
G	49	Ethanol	existing	Fermentation	Starch factory rejects collection tank	E10	183	1	183	0%	183	422	8.0	308	1.3	0.1	0.1	Non-Scalable to production
G	51	Ethanol	existing	Fermentation	Feed transfer to distillery	E22	167	1	167	50%	83	192	1.0	20		0.1	0.1	Non-Scalable to production

pae holmes

H		Ethanol	approved	Fermentation	New fermentation vent (EPA DP 17)	FERM10	9,045	1	9,045	0%	9,045	20,804	28.0	303	14.7	6.5	0.2	Fermenter filling - emissions occurs for first 4.5 hours of each fermenter fill (4.5 hours) then reverts to ethanol recovery scrubber. Non-Scalable to production - batch process. OER and discharge parameters taken from SEMA measurements on No.12 Fermenter Discharge.
H		Ethanol	approved	Fermentation	New fermentation vent (EPA DP 17)	FERM11	9,045	1	9,045	0%	9,045	20,804	28.0	303	14.7	6.5	0.2	Fermenter filling - emissions occurs for first 4.5 hours of each fermenter fill (4.5 hours) then reverts to ethanol recovery scrubber. Non-Scalable to production - batch process. OER and discharge parameters taken from SEMA measurements on No.12 Fermenter Discharge.
					New fermentation vent 12		9,045	1	9,045	0%	9,045	20,804	28.0	303	14.7			Fermenter filling - emissions occurs for first 4.5 hours of each fermenter fill (4.5 hours) then reverts to ethanol recovery scrubber. Non-Scalable to production - batch process. OER and discharge parameters taken from SEMA measurements on No.12 Fermenter Discharge.
					New fermentation vent 13		9,045	1	9,045	0%	9,045	20,804	28.0	303	14.7		0.3	Fermenter filling - emissions occurs for first 4.5 hours of each fermenter fill (4.5 hours) then reverts to ethanol recovery scrubber. Non-Scalable to production - batch process. OER and discharge parameters taken from SEMA measurements on No.12 Fermenter Discharge.
					New fermentation vent 14		9,045	1	9,045	0%	9,045	20,804	28.0	303	14.7		0.3	Fermenter filling - emissions occurs for first 4.5 hours of each fermenter fill (4.5 hours) then reverts to ethanol recovery scrubber. Non-Scalable to production - batch process. OER and discharge parameters taken from SEMA measurements on No.12 Fermenter Discharge.
					New fermentation vent 15		9,045	1	9,045	0%	9,045	20,804	28.0	303	14.7		0.3	Fermenter filling - emissions occurs for first 4.5 hours of each fermenter fill (4.5 hours) then reverts to ethanol recovery scrubber. Non-Scalable to production - batch process. OER and discharge parameters taken from SEMA measurements on No.12 Fermenter Discharge.
					Ethanol Recovery Scrubber Discharge		5,299	1	5,299	0%	5,299	12,187	28.0	300	10.8		0.3	New source. Emission occurs for 50% of time of fermenter fill, then remaining 45 hours of batch.
					Stillage Surge Tank Discharge		173	1	173	0%	173	397	2.0	360	3.3		0.2	New source. In use on average 1.5 days per week.
		Flour Mill	approved	Pneumatic fans	cyclone and fabric filter	4	1,654	1	1,654	0%	1,654	3,804	33.0	313	6.0		3.0	Non-Scalable to production
		Flour Mill	approved	Pneumatic fans	cyclone and fabric filter	5	617	1	617	0%	617	1,420	33.0	313	6.0		1.6	Non-Scalable to production
		Flour Mill	approved	Cleaning section	cyclone and fabric filter	6	1,477	1	1,477	0%	1,477	3,398	33.0	311	6.0		1.6	Non-Scalable to production
		Flour Mill	approved	Aspiration points	cyclone and fabric filter	7	551	1	551	0%	551	1,268	33.0	297	9.0		0.8	Non-Scalable to production
G	23	Glucose	existing	Confectionary	Drum vacuum receiver	C4	3,500	1	3,500	0%	3,500	8,050	21.0	314	20.0	20.0	0.2	Non-Scalable to production
G	46	Glucose	existing	Confectionary	Ion exchange effluent tank	C18	250	1	250	0%	250	575	2.5	307	0.2	0.1	0.3	Non-Scalable to production
G	37	Glucose	existing	Brewers	Cooker A & B Flash Tanks	B3	950	1	950	0%	950	2,185	24.0	373	2.8	2.8	0.3	Non-Scalable to production
G	20	Starch	existing	Starch building m	Dry gluten roof bin	S7	4,500	1	4,500	0%	4,500	10,350	25.0	328	15.0	0.1	0.7	Non-Scalable to production
G	39	Starch	existing	Starch building m	High protein dust collector	S8	600	1	600	0%	600	1,380	24.5	316	12.0	0.1	0.4	Non-Scalable to production
G	44	Starch	existing	Starch building m	Flour bin motor drive	S6	283	1	283	0%	283	652	24.0	307	18.0	0.1	0.3	Non-Scalable to production
G	35	Starch	existing	Grain plant	Flour bin aspirator	S13B	500	2	1,000	0%	1,000	1,150	2.5	306	22.0	0.1	0.4	Non-Scalable to production
G	35	Starch	existing	Grain plant	Flour bin aspirator	S13A	500	2	1,000	0%	1,000	1,150	2.5	306	22.0	0.1	0.4	Non-Scalable to production
G	43	Starch	existing	Grain plant	Pellet silo	S12	350	1	350	0%	350	805	2.0	304	25.0	0.1	0.3	Non-Scalable to production
A	1	Starch	existing	Dryers	No. 4 Gluten Dryer baghouse	S5	13,331	1	13,331	25%	9,998	22,996	30.0	350	6.7	0.1	2.7	Non-Scalable to production
A	3	Starch	existing	Dryers	No. 3 Gluten Dryer baghouse	S3	19,501	1	19,501	25%	14,625	33,638	21.0	340	7.2	0.1	2.5	Non-Scalable to production
A	6	Starch	existing	Dryers	No. 1 Gluten Dryer baghouse	S2	13,182	1	13,182	25%	9,886	22,738	25.5	347	2.5	0.1	3.2	Non-Scalable to production
A	10	Starch	existing	Dryers	No. 2 Gluten Dryer baghouse	S4	5,511	1	5,511	25%	4,133	9,506	27.0	328	2.1	0.1	3.2	Non-Scalable to production
					No. 6 Gluten Dryer		12,568	1	12,568	0%	12,568	28,906	35.0	343	22.4		1.7	Non-Scalable to production. New source sampled. No reduction applied
					No. 7 Gluten Dryer		9,553	1	9,553	0%	9,553	21,972	30.0	336	18.9		1.7	Non-Scalable to production. New source sampled. No reduction applied

A	12	Starch	existing	Dryers	No. 4 Starch Dryer	STS	7,151	1	7,151	25%	5,363	12,335	20.0	319	21.0	21.0	1.2	Non-ticeable to production
A	19	Starch	existing	Dryers	No. 3 Starch Dryer	STS	6,436	1	6,436	25%	4,827	11,102	20.0	316	23.0	23.0	1.2	Non-ticeable to production
A	25	Starch	existing	Dryers	No. 1 Starch Dryer	STI	10,667	1	10,667	0%	10,667	25,270	26.0	316	7.1	0.1	1.3	Non-ticeable to production. Re-tested for new scrubber. No reduction applied
		Starch	approved	Dryers	No. 5 Starch Dryer	S	0	1	0	25%	0	0	32.0	326		25.0	1.6	Not needed for 300 ML
D	36	Starch	existing	Dryers	Spray dryer	SDD	963	1	963	25%	736	1,696	19.0	335	6.8	0.1	1.4	Non-ticeable to production
						BOILR2					13,104	PG ver	22.0	462	7.5	7.5	1.4	
						BOILR4			2,746		2,746	PG ver	39.0	443	14.0	14.0	1.1	Re-tested. Now gas fired. Assumed scalable to production to be conservative.
C		Boiler			Boiler No. 5 & 6 (EPA OP 35) coal combustion odour	BOILR5			56,120	0%	56,120	PG ver	53.6	397	13.5	13.5	2.05	Re-tested. Assumed scalable to production as worst case. Assumed scalable to production to be conservative.
					Bio-filter	BIOFIL	5.03	1	5.03		5.03	PG ver						Duplication of biofilter - Mid 2012. Double size at same location
D	18	DDG	existing	Loadout	DDG Load Out Shed - Awning	DDG05	903	1	903	0%	903	2,125	volume source - see attached sheet					Non-ticeable to production
					"Wet legged" sources													
D	47	DDG	existing	Liquids line	Decanter feed tank	DDG1	217	1	217	50%	108	249	0.5	20		0.1	0.1	Non-ticeable to production
D	33	Ethanol	existing	Fermentation	Jet cooker 2 & 4 - Grain retention	E7	1,133	1	1,133	50%	567	1,303	9.0	373	3.1	2.2	0.1	Non-ticeable to production
D	15	Farm	existing	Factory collection	Farm tank	F15	7,867	1	7,867	50%	3,934	8,917	0.5	20		0.1	0.1	Non-ticeable to production
D	21	Glucose	existing	Blowers	Enzyme Tanks	E7	583	7	4,083	50%	2,042	4,696	6.0	327	0.3	0.3	0.5	Non-ticeable to production

					Sources to bio-filter - not modelled as individual sources												
	13	DDG	existing	Liquids line	Feed dump	DDG20	8,917	1	8,917	85%	1,338		dust to biscrubber				N/A
	6	DDG	existing	Liquids line	Condensate	DDG23	25,711	1	25,711	85%	3,857		dust to biscrubber				N/A
	22	DDG	existing	Liquids line	Vent condensor	DDG24	3,500	1	3,500	85%	525		dust to biscrubber				N/A
	8	DDG	existing	Liquids line	Finish Feed	DDG25	18,333	1	18,333	85%	2,750		dust to biscrubber				N/A
	30	DDG	existing	Liquids line	Finisher pump tank	DDG26	1,433	1	1,433	85%	215		dust to biscrubber				N/A
	29	DDG	existing	Liquids line	Dryer feed tank	DDG30	1,433	1	1,433	85%	215		dust to biscrubber				N/A
	32	DDG	existing	Liquids line	Feed holding tank (thynal)	DDG31	1,317	1	1,317	85%	198		dust to biscrubber				N/A
	41	DDG	existing	Liquids line	CIP - fresh caustic	DDG32	417	1	417	85%	63		dust to biscrubber				N/A
					PONDS (see Area Sources sheet)												
							BOER (OU minimize)										
					Pond 1	POND1	0.198	1	0.198		0.198	PG ver					Non-ticeable to production
					Pond 2	POND2	0.283	1	0.283		0.283	PG ver					Non-ticeable to production
					Pond 3	POND3	0.046	1	0.046		0.046	PG ver					Non-ticeable to production
					Pond 4	POND4	0.129	1	0.129		0.129	PG ver					Non-ticeable to production
					Pond 5	POND5	0.049	1	0.049		0.049	PG ver					Non-ticeable to production
					Pond 6	POND6	0.064	1	0.064		0.064	PG ver					Non-ticeable to production
					BO Basin	BOBAS	0.033	1	0.033		0.033	PG ver					Non-ticeable to production
					Membrane Bio-Reactor	MBR	0.061	1	0.061		0.061	PG ver					Non-ticeable to production

ANNEXURE 2

ANNEXURE 2

Landscape and Vegetation Management Plan (LVMP)

prepared by

Coffey Environments
(in accordance with Condition 43 of Project Approval MP06_0228)

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

SHOALHAVEN STARCHES ETHANOL PLANT
LANDSCAPE AND VEGETATION MANAGEMENT PLAN

Prepared for:

Manildra Group
Shoalhaven, NSW

Report Date: 26 May 2009
Project Ref: ENVIWOLL00187AC

Written/Submitted by:

Jennifer Parnell

Mathew Misdale

Reviewed/Approved by:

Dr Paul Van De Moezel

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

1 July 2009

Manildra Group
Shoalhaven, NSW

Attention: Greg Murphy

Dear Greg

RE: Landscape and Vegetation Management Plan

Coffey Environments is pleased to present Manildra with the Landscape Vegetation Management Plan, to meet condition 43 of the Environmental Assessment Report for the planned expansion of the Shoalhaven Starches Factory.

Please refer to the attached sheets titled "Important Information about your Coffey Environments Report". These sheets should be read in conjunction with this report.

Thank you for your commission for this work and we look forward to the opportunity of being of assistance in the future. Should you have any questions in relation to the report, please do not hesitate to contact the undersigned.

For and on behalf of Coffey Environments Pty Ltd

Jennifer Parnell
Environmental Management Consultant

cc Steven Richardson
Cowman Stoddart

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1	ENVIWOLL00187AC_v2.doc	Final	1 July 2009	Manildra Group	JP
1	ENVIWOLL00187AC_v2.doc	Final	14 September	Manildra Group	JP

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LIST OF ATTACHMENTS

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ABBREVIATIONS

DA	Development Application
DECC	Department of Environment and Climate Change NSW
DNR	Department of Natural Resources (now DWE)
DoP	Department of Planning NSW
DPI	Department of Primary Industries NSW
DWE	Department of Water and Energy NSW
EA	Environmental Assessment
EAR	Environmental Assessment Report
EP&A	*Environmental Planning and Assessment Act 1979*
LVMP	Landscape and Vegetation Management Plan
NWA	*Noxious Weeds Act 1993*
RCMS	Riparian Corridor Management Study

1 INTRODUCTION

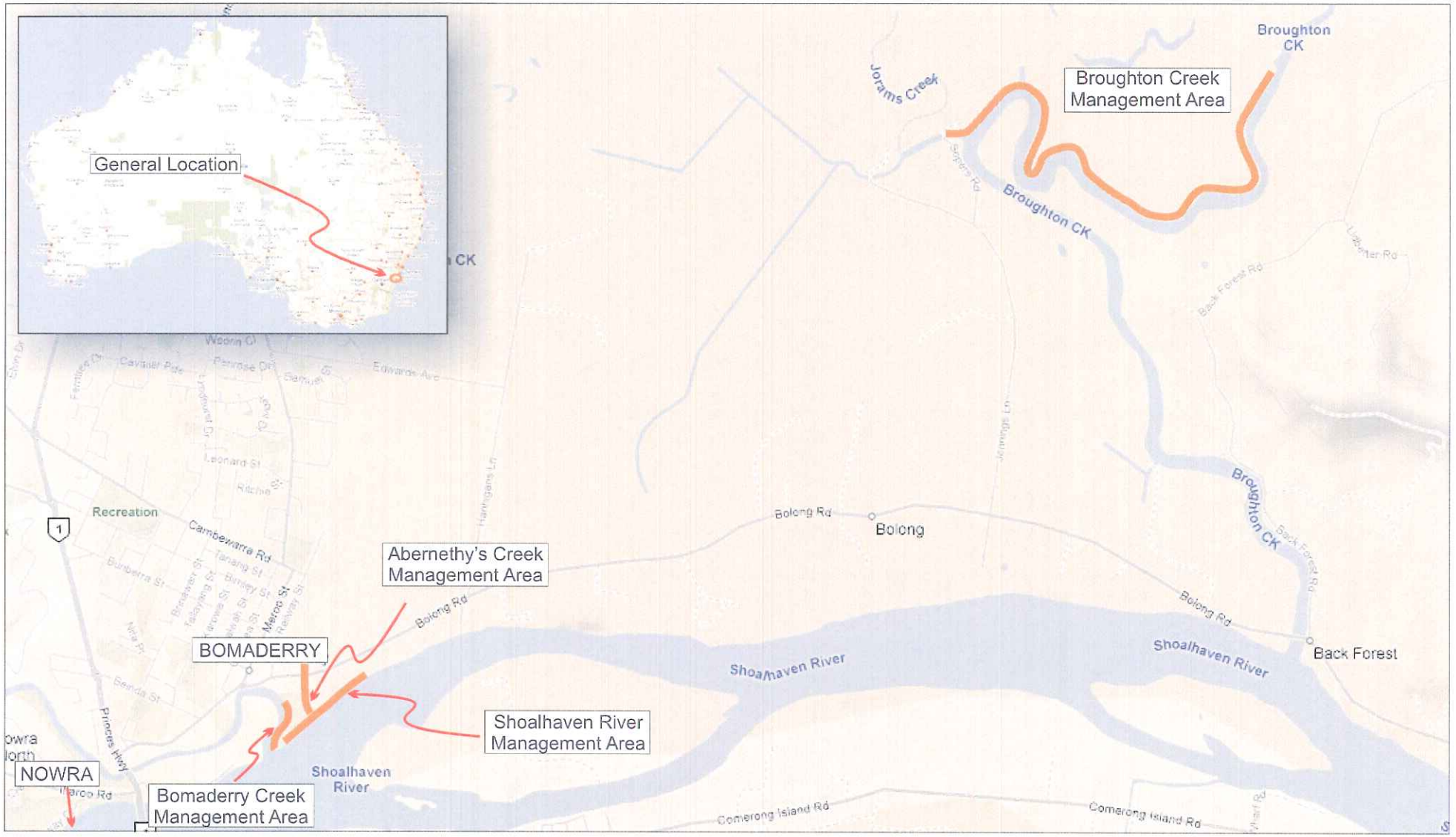
1.1 Background

The Manildra Group has successfully applied to increase its ethanol production capacity from 126 million litres per year to 300 million litres a year, at the Shoalhaven Starches factory located on Bolong Road, Bomaderry NSW. To accomplish this increase, plant infrastructure will be constructed and/or upgraded and raw material inputs will increase.

A Part 3A Environmental Assessment (EA) was prepared by Cowman Stoddart (2008) on behalf of Manildra Group to accompany the Development Application. The EA detailed a series of commitments relating to landscaping and enhancing riparian zones onsite, drawing on the information and recommendations provided in Coffey Environments (2008) *Riparian Assessment*.

The Development Application was conditionally approved in January 2009. Condition 43 of the Notice of Approval (DoP, 2009) requires the preparation of a Landscape and Vegetation Management Plan, to be submitted for approval to the Director General (Department of Planning) within six months of the issue of the Notice of Approval.

Shoalhaven Starches factory site is located between the Shoalhaven River and Bolong Road. The western border is adjacent to the mouth of Bomaderry Creek as it flows into Shoalhaven River. Abernethy's Creek transects the factory site and also flows into Shoalhaven River. The wastewater treatment plan and irrigation farm is located approximately 1-2km north-east of the factory. Broughton Creek forms the boundary of the farm for approximately 3.6km. **Figure 1** shows the factory and farm in relation to the four watercourses.



coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

Drawn	AM
Approved	
Date	29/04/09
Scale	NTS

LVMP SHOALHAVEN STARCHES
Site Locality in Relation to 4 Watercourses

Original Size	A4
Project no:	ENVIIWOLL00187AC
Figure	1

ENVIWOLL00187AC_fig1.pdf

1.2 Objectives and tasks

This Landscape and Vegetation Management Plan (LVMP) has been prepared, in consultation with Department of Water and Energy (DWE), to satisfy the requirements of Condition 43 Schedule 3 of the Notice of Approval. Specifically, the objectives are to:

- Prepare a Landscape Plan for the project which identifies screen plantings to minimise visual impacts
- Prepare detailed plans and procedures to:
  - Restore and maintain the waterways and riparian zones of Shoalhaven River, Bomaderry Creek, Abernethy's Creek and Broughton Creek on the site
  - Manage weeds in the vicinity of the riparian zones
  - Integrate works into the proposed landscaping for the rest of the site
  - Manage impacts on fauna
  - Monitor the performance of the proposed restoration works

In preparing the LVMP, Coffey Environments has undertaken the following tasks:

- Review previous reports and relevant guidelines and consult with DWE
- Conduct a site walkover
- Identify screening areas and outline planting procedures and scheduling, preferred species and maintenance requirements
- Prioritise riparian areas requiring plantings, enhancement measures and restoration works and spatially define these areas in a series of diagrams/maps
- Develop an action plan and planting schedule outlining methods and procedures for plantings, enhancement and rehabilitation of riparian zones, including:
- Measures to manage fauna impacts
- Measures to control access
- Maintenance requirements for new plantings
- Develop a weed management plan outlining methods and procedures for the control and eradication of high priority weed species in riparian zones
- Develop an ongoing monitoring plan to assess the success of plantings, enhancement measures and restoration works onsite
- Provide a list of local suppliers

1.3 Guidelines

The LVMP has been developed in consultation with the Department of Environment and Water (DWE) and draws on following guidelines:

- DWE (2008a) Guidelines for Controlled Activities: Riparian Corridors
- DWE (2008b) Guidelines for Controlled Activities: Vegetation Management Plans

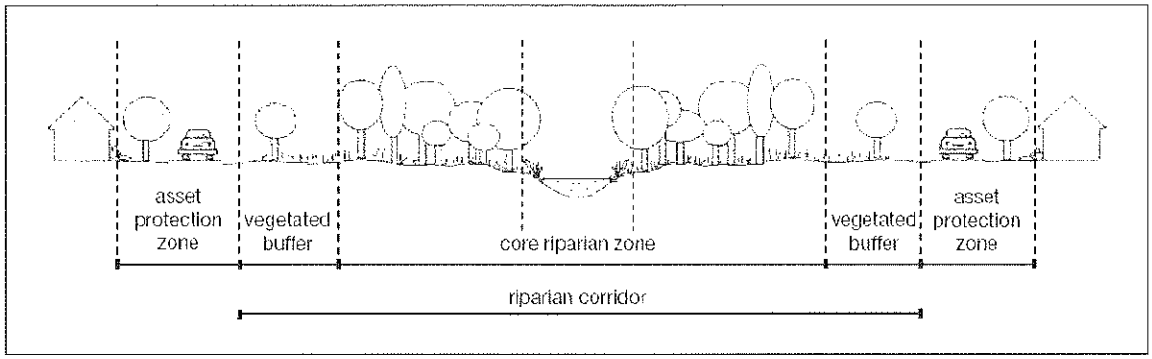
These guidelines are provided in the library for reference.

Guidelines for Controlled Activities: Riparian Corridors

These guidelines outline the recommended corridor riparian zone widths to be considered in the design of controlled activities, with emphasis on ensuring the protection or restoration of riparian areas to improve geomorphic form and ecological functions of the watercourse.

The expansion of the factory site was considered a controlled activity due to the close proximity of the site to Shoalhaven River, Bomaderry Creek and Abernethy's Creek. It was therefore a requirement for DWE to assess the impact of the controlled activity to ensure minimal harm is done to any waterfront land.

Riparian corridor zones



*1. A **Core Riparian Zone (CRZ)** is the land contained within and adjacent to the channel. The Department will seek to ensure that the CRZ remains, or becomes vegetated, with fully structured native vegetation (including groundcovers, shrubs and trees). The width of the CRZ from the banks of the stream is determined by assessing the importance and riparian functionality of the watercourse (Table 1), merits of the site and long-term use of the land. There should be no infrastructure such as roads, drainage, stormwater structures, services, etc. within the CRZ.*

*2. A **Vegetated Buffer (VB)** protects the environmental integrity of the CRZ from weed invasion, micro-climate changes, litter, trampling and pollution. There should be no infrastructure such as roads, drainage, stormwater structures, services, etc. within the VB. The recommended width of the VB is 10 metres but this depends on merit issues.*

*3. An **Asset Protection Zone (APZ)** is a requirement of the NSW Rural Fire Service and is designed to protect assets (houses, buildings, etc.) from potential bushfire damage. The APZ is measured from the asset to the outer edge of the vegetated buffer (VB). The APZ should*

contain cleared land which means that it can not be part of the CRZ or VB. The APZ must not result in clearing of the CRZ or VB. Infrastructure such as roads, drainage, stormwater structures, services, etc. can be located within APZs.

Recommended riparian corridor and buffer zone widths specific to the four watercourses onsite were identified by DWE and are shown in **Table 1**. The recommendations were based on the stream classification system developed through the RCMS process (DNR, 2004).

Table 1: Watercourse classification and recommended buffer zones

WATERCOURSE	CATEGORY	RECOMMENDED CRZ	RECOMMENDED VB
Shoalhaven River	Cat 1	40m	10m
Bomaderry Creek	Cat 1	40m	10m
Broughton Creek	Cat 1	40m	10m
Abernethy's Creek	Cat 2	20m	10m

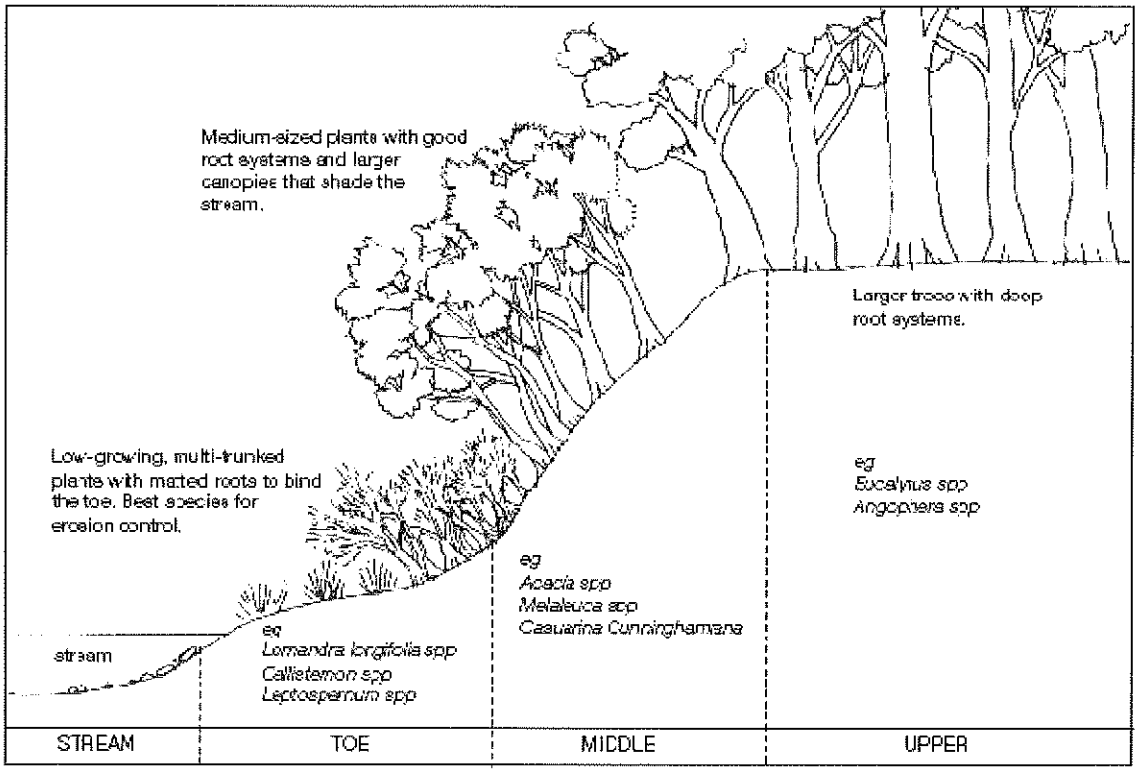
With the exception of the confluence of Shoalhaven River and Bomaderry Creek and Abernethy's Creek north of Bolong Road, the existing infrastructure and buildings at the factory limit the available space necessary to meet the above recommended buffer zones. In addition, some foreshore areas along Broughton Creek are utilised as part of the farm for stock refuge and road access to the pivots, which also limit the space necessary to meet the recommended buffer zones. Due to these restrictions, this plan focuses on improving bank stability and riparian diversity and health within the foreshore areas available. Where it is feasible to do so, the long term objective is to extend riparian zones to meet the recommendations of DWE.

Guidelines for Controlled Activities: Vegetation Management Plans

These guidelines outline the criteria which need to be addressed in a Vegetation Management Plan (VMP) for controlled activities near riparian corridors. The objective of a VMP is to provide for a stable watercourse and riparian corridor which emulates the native vegetation communities in the area. The diagram below illustrates a typical riparian corridor cross section.

To achieve this, VMPs need to address both bank stability and ecology, and provide detailed actions and procedures to complete revegetation and enhancement works including ongoing maintenance and a process for monitoring and review.

Typical riparian corridor cross section



Adapted from Raine, A. & Gardiner, J (1995) Rivercare Guidelines for Ecological Sustainable Management of Rivers and Riparian Vegetation, cited in DWE, 2008a.

1.4 Management zones

Management zones have been developed to allow the prioritisation of actions in the riparian corridors of the four watercourses. The management zones only apply to riparian areas, the landscaping component of this plan is dealt with separately. The following provides a summary of the management zones:

Zone A management areas - address priority bank stability issues and recommended actions aimed at a) improving bank stability, and b) creating and/or enhancing native vegetation communities through new plantings and weed eradication

Zone B management areas - address riparian vegetation health and recommended actions aimed at enhancing native vegetation through restoration works (fill-in planting, thinning etc) and weed eradication and/or control

Zone C management areas - address riparian vegetation health and recommended actions aimed at controlling weeds and assisting native regeneration

The management zones are indicative of the requirement of action only. Currently there are several areas along Broughton Creek that are excellent examples of structurally and floristically diverse riparian vegetation on the Shoalhaven Floodplain and farm management has been protecting them since 1997. It is imperative that these areas continue to be protected and maintained. However, as they do not require major works, they have been designated as Zone C.

The following table provides greater detail on what actions each management zone would entail.

It is anticipated that Zone A areas would transition to Zone B areas, and Zone B areas would transition to Zone C areas and so on, within 2-3 years of the commencement of restoration works.

1.5 Current works

Several programs aimed at habitat restoration/bank stability and enhancing riparian vegetation are currently underway or have been recently been completed. The following information has been provided by Manildra:

- The SEPP Wetland No 369 was permanently fenced off in 1997
- This official wetland was then linked into the next phase of the fencing program in 2003, resulting in almost the entire Broughton Creek frontage being protected from stock
- Planting of Mangrove species along suitable parts of the waterline of Broughton Creek was done in 2005 and 2006. These plantings have had some success with several individuals (up to 2 metre high) appearing to be partially established. Realignment of the fence in one section protects a mature stand of Melalueca stypheliodes, with potential for younger individuals to establish. The habitat restoration work was funded by the Environmental Services Scheme, a NSW state Government initiative
- Recent funding from Southern Rivers Catchment Management Authority (SRCMA) has been obtained to protect a high bank frontage of Broughton Creek which is used as a flood refuge for stock. The area will be assessed for potential bank stability work. Revegetation will commence only after any engineering has been completed. Adjustments to the fence-line, where possible, will enlarge terraces to allow a wider area to plant mid to high canopy plantings adjacent to already protected salt marsh habitat
- Approximately 700 metres of screen planting at the Farm along Bolong Road was established in 2007 as part of the Water Recovery Plant
- Weed suppression is part of the routine electric fence-line maintenance undertaken by the Farm workers along the Broughton Creek frontage
- Contractors are engaged to maintain the other Bomaderry, Shoalhaven and Abernathy's riparian areas
- Existing landscape plantings screen the BOC plant. These will have to be modified so to complete the approved upgrade to the Emergency Fire System
- Some trees need to be removed for vehicular access, maintenance and utility protection i.e. wastewater, optic fibre, power and gas. Additional planting will have to rescreen the new Fire Tanks and BOC facility. Riparian planting at the BOC should not be affected by the Fire System Upgrade

- Previous planting of canopy trees at the rear of the bank along the Shoalhaven River have established well. These are almost high enough to provide additional screening to the Evaporators
- The new planting to screen the new Cooling towers along Bolong Road is complete. Additional individuals to provide additional height will be added or if replacement is required

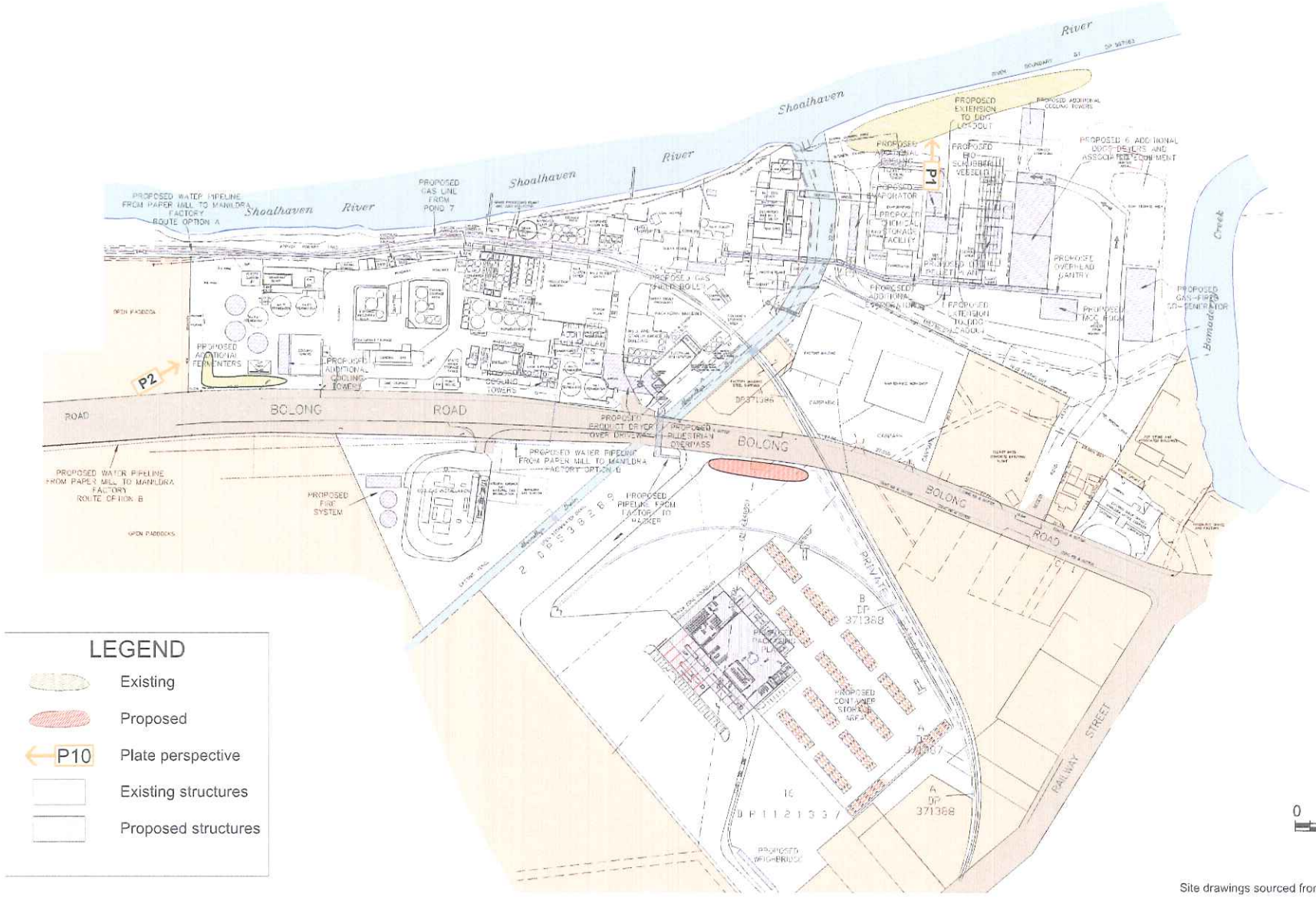
1.6 Consultation activities

In accordance with Condition 43 of the Notice of Approval, DWE has been consulted directly regarding the scope and content of the LVMP. Several informal discussions with DWE representative from the Nowra Office took place, in which advice was sought regarding the content and layout of the LVMP, and significant issues to be addressed.

As part of the review process, this document will be reviewed by DWE and Shoalhaven City Council prior to submission to the Department of Planning.

Screen Plantings

Screen Plantings



Site drawings sourced from Allen Price and Associates

2.1 Landscaping

The Environmental Assessment (Cowman & Stoddart, 2008) for the proposed expansion outlines three areas that require landscaping to screen new buildings and equipment:

- The embankment between Shoalhaven River and the proposed evaporator columns
- The north-eastern and eastern boundaries of the proposed fermenters
- Between Bolong Road and the southern boundary of the proposed packing plant

In addition to this, Manildra have indicated they will modify the existing screen planting at the BOC as part of the Emergency Fire System upgrade to ensure adequate screening of the facility is in place.

Evaporator columns

This area has a semi mature tree-line of *Casuarinas* and some *Eucalyptus* and *Melaleuca* species (7-10m) with growth potential to extend this height. This vegetation is currently of sufficient height to provide adequate screening of the new evaporation columns from Shoalhaven River (**Plate 1**). The recommendations outlined in the EA for screen plantings in this area are not considered necessary. However, some maintenance of the area such as weed control and enhancement plantings will contribute to the future resilience of the riparian vegetation of Shoalhaven foreshore.

Fermenters

This area has been mounded to facilitate drainage and some plantings have recently been undertaken by Manildra personnel (**Plate 2**) between the fermenters and Bolong Road. These plantings include many small to medium height shrubs (2-5m maximum height). Further expansions between the proposed fermenters and adjacent property are anticipated and it is likely that further plantings would need to be removed. Therefore it is recommended that additional *Casuarina glauca's* are planted in the existing planting to add height and screen the fermenters from Bolong Road.

Packing plant

This area is currently an open paddock of Kikuyu grass and some Lantana and Blackberry along the fence line. A mixed species screen of *Melaleuca*, *Eucalyptus* and *Casuarina* species should be planted between the south-eastern corner and the proposed Bolong pedestrian overpass, with a 5m setback from the fence line. It is recommended that the Blackberry and Lantana be removed in preparation for planting.

This planting is based on the packing plant layout of August 2008 and may need to be modified if the layout changes.

Note: Manildra have indicated that additional voluntary screen plantings will be completed on the eastern side of the proposed fire system, north of Bolong Road.

BOC plant

A vegetative screen for the BOC plant was installed on completion of construction works; however Manildra have indicated that this screen planting will need to be modified as part of the upgrade to the Emergency Fire System. The upgrade will involve the removal of several trees for vehicular access, maintenance and utility protection (i.e. wastewater, optic fibre, power and gas). On completion of the upgrade, a trees and shrubs will be planted to screen the new Fire Tanks and the existing BOC Plant.

These works will not interfere in any way with riparian enhancement works recommended for Abernethy's Creek.

2.2 Planting and maintenance

Planting and maintenance requirements for screen plantings are outlined in the following table. **Section 7 Procedures** provides greater detail.

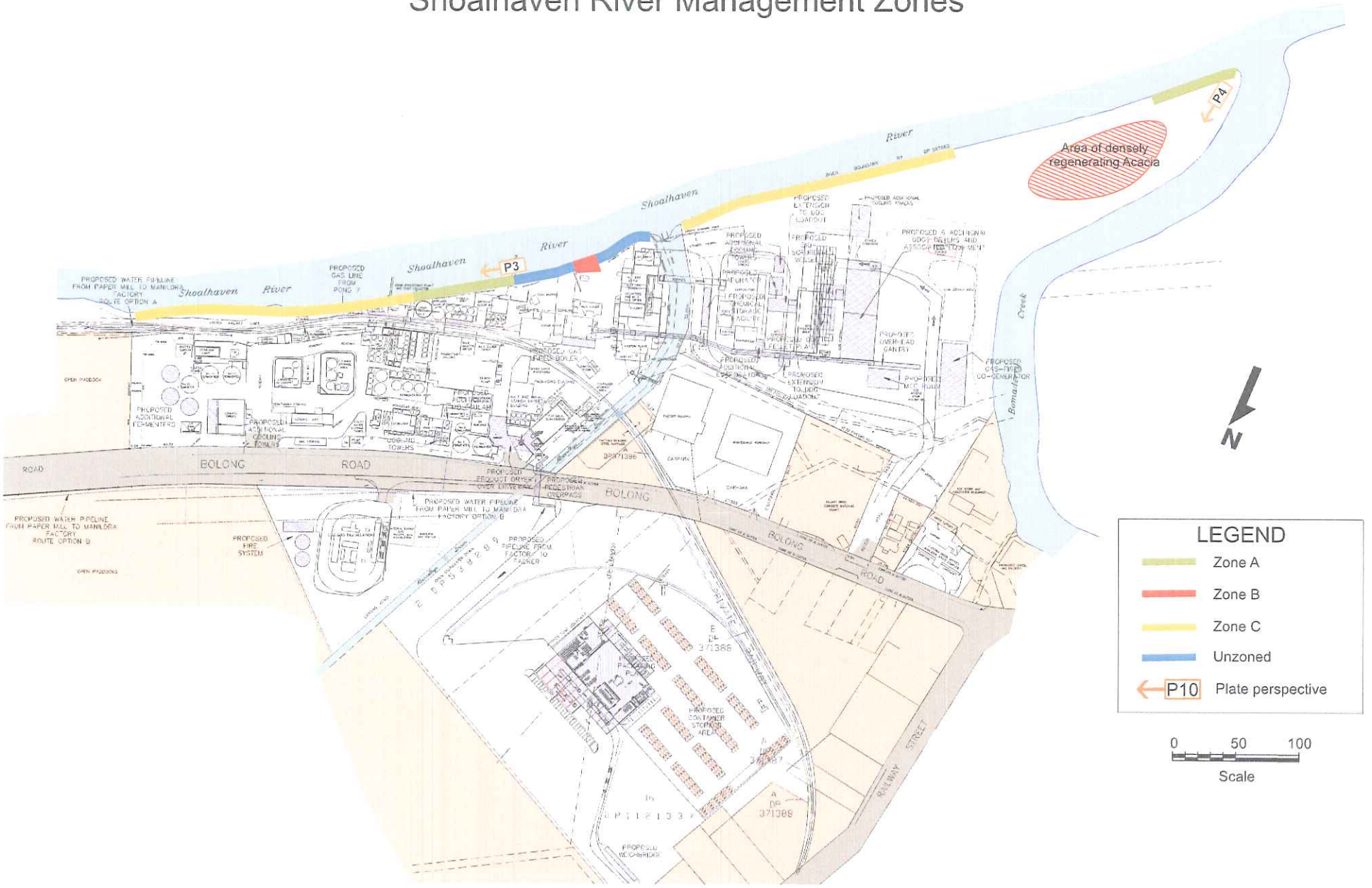
Table 2: Planting and maintenance requirements for screen plantings

	EVAPORATOR COLUMNS	FERMENTERS	PACKING PLANT
SPECIES	-	*Casuarina glauca*	*Refer to Attachment A (screening species list)*
DENSITY	-	Trees & large shrubs @ 1.5m Fill in with ground layer species	Trees & large shrubs @ 2m Fill in with ground layer species
MULCH	-	Leaf mould or bark chips @ 10cm	Leaf mould or bark chips @ 10cm
WATERING	-	Min fortnightly for 6 weeks *	Min fortnightly for 6 weeks *
WEED CONTROL	Spot spray scattered Lantana with herbicide (e.g. glyphosate) monthly for 3 months	Spot spray with broad spectrum herbicide (e.g. glyphosate) monthly for 3 months	Remove Blackberry and Lantana prior to planting
MONITORING	Refer Section 7.3	Refer Section 7.3	Refer Section 7.3

* Watering regime is dependent on weather conditions

Shoalhaven River

Shoalhaven River Management Zones



Site drawings sourced from Allen Price and Associates

Shoalhaven River is characterised by small narrow terraces with a relief of approximately 2-5m. The river flow is steady with minimal surface roughness. The factory is located on the foreshore, with some areas with less than 20m from the hardened area to the waterline.

Naturally occurring deposition on the western end of Pig Island has channelled water along the edge of Shoalhaven River where the factory is located, encouraging scouring of the river bank.

The riparian vegetation fronting Shoalhaven River has been highly modified. The vegetation west of Abernethy's drain consists of a number of mature remnant trees such as *Eucalyptus botryoides* and *Casuarina glauca*. Further downstream, east of the drain, the bank and upper bank is dominated by opportunistic colonisers, primarily Coral trees (*Erythrina x sykesii*) that have established over the past 20-50 years. Coral trees spread by coppicing. They have very weak wood so they fall over easily and spread further. Coral trees are known to undermine bank stability.

3.1 Zone A

Two areas along the foreshore of Shoalhaven River have been designated as 'Zone A' for management purposes:

1. The emergency revetment and the area behind it, up to the boundary of the new flour mill processing plant
2. The area at the confluence of Shoalhaven River and Bomaderry Creek zoned *f(3) Foreshores Protection*

Emergency revetment

The emergency revetment was installed in early 2008 to remediate slumping of the vertical bank. New plantings of native species were completed on, and directly to the rear of, the revetment. However, a visual inspection of the area reveals many of these seedlings have died or been inadvertently sprayed during the maintenance weed spray program.

Currently, the vegetation directly adjacent to the revetment is dominated by Coral trees and perennial grasses (including Kikuyu grass). Young Coral trees where also observed within the revetment (**Plate 3**) and will need to be removed as soon as possible.

Establishing riparian vegetation and improving long term bank stability will need to be undertaken in a staged manner and will take several years to complete. Measures should include:

- Removing immature Coral trees from within the rocks of the revetment
- Frilling of stumps (manual treatment with herbicide as opposed to broad scale spraying) and removing new growth regularly during spring and summer
- Planting fast growing native species, such as Casuarina glauca, in the exposed area behind the revetment and where sucker growth has been contained
- Planting a mixture of Eucalyptus and Melaleuca Spp. to provide a diverse canopy of tree species with deep binding root systems and a screen for the new flour mill
- Planting *Lomandra longifolia* and other tufting / dense growing groundcover between the proposed flour mill and the riparian area to reduce sediment discharges into the river

A full list of species is provided in **Attachment A**, under 'rear of bank'.

The area behind the revetment was affected by construction activities at the time of the site visit and therefore replanting measures will not be possible until the flour mill is completed.

Notwithstanding, remediation measures will be undertaken on the revetment wall as soon as possible, in particular the removal of young Coral trees. Recommendations for revetment planting were made previously in a letter report by Allison Hunt & Associates (2008) when the revetment was first installed and these recommendations should be implemented again. The letter report is provided in **Attachment B** for reference.

Confluence Shoalhaven River and Bomaderry Creek

The vegetation in this area is mostly open and dominated by Kikuyu grass with some Lantana along the water's edge at the mouth of Bomaderry Creek (**Plate 4**). On the western side of the mouth at the water's edge there is a pavement, which may have been an old boat ramp. There is a low old barbed wire fence approximately 10-20m back from the bank.

The confluence is a designated waterway and any obstruction at the toe of the bank and in stream may be considered a navigational hazard.

To improve bank stability, and enhance riparian vegetation and landscape connectivity, restoration works should be completed from the lower bank to the barbed wire fence, an area approximately 10-20m wide and 100m in length. It is recommended that restoration works be completed in two sequential stages with Stage 1 works commencing within 12 months of the finalisation of this plan:

- Stage 1 – enhancement planting and weed control from the lower bank to 10m behind the bank
- Stage 2 – within 12-18 months of successful completion of Stage 1, enhancement planting a further 10m behind Stage 1

Proposed works for Stage 1 will involve:

- Slashing Kikuyu grass with follow-up broad scale spray with Glyphosate or similar herbicide
- Eradicating African Boxthorn (refer to the Library for noxious weed eradication methods)
- Removing of Lantana through cut and paint techniques using either neat Glyphosate or recommended herbicide (Library)
- Planting a fast growing species at the top of the bank such as *Myoporum* and *Casuarina glauca*
- Planting canopy species at the rear of the bank such as *Casuarina glauca* and *Eucalyptus botryoides*
- Planting a variety of groundcover species selected from the list provided in **Attachment A**
- Implementing maintenance and monitoring measures as described in Section 7 of this report.

Proposed works for Stage 2 should be undertaken once Stage 1 plantings have successfully established (approximately 12-18 months) and will involve:

- Slashing Kikuyu grass with follow-up broad scale spray with Glyphosate or similar herbicide
- Removing of Lantana through cut and paint techniques using either neat Glyphosate or recommended herbicide (Library)
- Eradicating other weeds species from the area (e.g. Blackberry, African Boxthorn, Lantana, Privet)

- Planting out canopy, midstorey and groundcover species (**Attachment A** rear of bank)

3.2 Zone B

Two areas along the Shoalhaven River foreshore have been identified as Zone B management areas:

1. Large area of densely regenerated *Acacia mearnsii*, starting approximately 150m east of Bomaderry Creek and continuing eastwards for approximately 175m
2. Small grassy area directly behind the crib shed

Acacia mearnsii

The area of *Acacia mearnsii* is characterised by a dense canopy which is limiting further regeneration of other native species which are growing nearby along the river bank. There is also a dense understorey of Paddys Lucerne *Sida rhombifolia* around the outer edges of the copse restricting seedling regeneration.

The *Acacia mearnsii* has been estimated at around mid-life cycle and will die out leaving an area full of dead wood. Thinning and replanting with other canopy species such as *Casuarina glauca* and *Eucalyptus botryoides* will facilitate a transition to a more resilient and longer lived canopy. This would involve:

- Clearing 10m x 10m plots of acacias and replanting with other canopy species at a density of 2m
- Removing of acacia seedlings to ensure other canopy species become established
- Implementing maintenance and monitoring measures as described in Section 7 of this report

In the long term, a maximum of 1 or 2 individuals of Acacias per $50m^2$ is recommended, however, it will take some time to achieve this.

Crib shed

The small area behind the crib shed is dominated by long Kikuyu grass with some Lantana on the eastern edge. It is approximately 5m wide and slopes down towards the shed and the water. Some spraying is conducted along the fence line.

It is recommended that this area be planted out with a mixture of species identified as suitable for top of bank. This would involve:

- Spraying Kikuyu grass to within 2m of the water's edge
- Spot spraying Kikuyu grass (50cm diameter circles) along the water's edge
- Planting out the toe with waterline species
- Planting the area behind it with top of bank species
- Once the canopy species have developed and shaded out the Kikuyu grass, planting native groundcovers

3.3 Zone C

Two areas have been identified as Zone C management areas:

1. Between the eastern boundary of the site and the revetment, approximately 200m
2. From Abernethy's Creek floodgate 200m along the foreshore to the west

Eastern boundary

The vegetation in this area is currently dominated by scattered mature *Eucalyptus maculata* and *Casuarina cunninghamiana*. Lantana was observed in the understorey. Management measures for the area should include:

- Spraying Lantana with broad spectrum herbicide as manufacturer's recommended dosage
- Planting *Lomandra longifolia* in between the trees

Abernethy's Creek Floodgate heading west

The area from Abernethy's Creek floodgate heading west is further divided into two sections: the eastern section and western section.

The eastern section is characterised by mature *Casuarina glauca* and *Eucalyptus botryoides* with a dense to moderately dense understorey of Lantana. Management measures for this area should include:

- Removing Lantana using mosaic technique (where Lantana is sprayed in a chequered pattern and removed in stages so some plants remain to provide soil cover and fauna habitat – refer to the Library)
- In areas that are regenerating poorly, new plantings of midstorey and groundcover species should be considered
- Suppressing African Boxthorn and Blackberry

The western section displays a moderately diverse canopy where present, with relatively poor midstorey and groundcover diversity. Lantana is also present, although not as densely as in the eastern section. Management measures for this area should include:

- Spraying and removing Lantana
- Suppressing African Boxthorn and Blackberry

Reducing potential seed sources of Lantana will contribute towards the future resilience of riparian vegetation and reduce the requirement for future maintenance.

3.4 Unzoned

One area along the Shoalhaven River foreshore has not been classified with a management zone due to its problematic nature. This area is located between the crib shed and the emergency revetment.

The embankment is very steep and the vegetation consists almost entirely of Coral trees with a lower storey of Lantana (**Plate 5**). With the dominance of Coral trees, the likelihood of further slumping in the

area is high as fluvial scouring along this section of bank is also occurring. Nonetheless, as there is no other species present with a deep binding root structure, the removal of the Coral trees will result in a net loss of binding roots and further undermine bank stability in the short term.

A staged approach to removing Coral trees and planting out with native species is recommended. However, prior to any works being undertaken, a geotechnical assessment will be necessary to identify and manage areas prone to bank instability. Further revetments may need to be considered.

Bomaderry Creek

Bomaderry Creek Management Zones

Bomaderry Creek flows through the township of Bomaderry and Nowra North before converging with Shoalhaven River. The top of the bank ranged between 1-3m from the surface.

The majority of the upper bank of Bomaderry Creek is dominated by dense thickets of impenetrable Lantana. A number of mature casuarinas and acacias are present on the bank down to the water's edge. The understorey and ground layer, where present, are dominated by weed species including Lantana and African Boxthorn.

Further downstream near the convergence with Shoalhaven River, the riparian zone becomes more open. Near the mouth of the Creek, Kikuyu Grass dominates and there is little overstorey along the rear of the bank.

4.1 Zone A

The area immediately behind the bank, from the confluence with Shoalhaven River to 250m upstream, has been identified as a Zone A management area. The embankment is very steep and the vegetation is dense in areas. Vegetation on the upper bank is dominated by Kikuyu grass, which is currently slashed regularly.

The foreshore has experienced some recession. The following measures are recommended to improve riparian vegetation and bank stability:

- Spraying Kikuyu grass with Glyphosate at manufacturer's recommended dosage to reduce competition
- Planting the top of the bank with canopy species with deep root systems such as *Eucalyptus*, *Casuarina* and *Ficus rubiginosa* and midstorey species such as *Melaleuca styphelioides* and *Myoporum acuminatum*
- Planting groundcover such as *Lomandra longifolia* and *Dianella spp.* to improve resilience against further weed invasion and allow the canopy and midstorey species to develop

No weed species of concern were identified in the Zone A management area.

Refer to **Section 7** for planting, maintenance and monitoring procedures.

4.2 Zone B

Two areas have been identified along the Bomaderry Creek foreshore as Zone B management areas:

- The upstream embankment from the diary cooperative boundary approximately 100m to the south western bend of Bomaderry Creek
- The downstream embankment from the bend to the confluence with Shoalhaven River

Upstream embankment

This area consists of a moderately diverse canopy of Melaleuca, Casuarina and Eucalyptus species, and White Cedar (*Melia azederach).* The midstorey is dominated by dense Large Leaf Privet in shaded areas and Lantana in the more open light areas. A number of environmental and noxious weeds were observed and are noted in **Table 3**. It is recommended that weed eradication in this area target Class 3 and 4 noxious weeds, in particular Giant Parramatta Grass, Blackberry and African Boxthorn.

Table 3: Noxious and environmental weeds along Bomaderry Creek

NOXIOUS WEEDS	ENVIRONMENTAL WEEDS
Giant Parramatta Grass *Sporobolus africanus (Class 3)*	Moth vine *Araujia sericifera*
African Boxthorn *Lycium ferocissium (Class 4)*	Paddys lucerne *Sida rhombifolia*
Crofton Weed *Ageratina adenophora (Class 4)*	*Vernena spp*
Blackberry *Rubus fruticosus (Class 4)*	Turkey rhubarb *Acetosa sagittata*
Bridal Creeper *Asparagus asparagoides (Class 5)*	Fleabane *Conzya bonariensis*
Lantana *Lantana camara (Class 5)*	Farmers friend *Bidens pilosa*
	Panic veldt grass *Ehrharta erecta*
	Trad *Tradescantia alba*
	Camphor laurel *Cinnamomum camphori*
	Small Leaf Privet *Ligustrum sinense*
	Large Leaf Privet *Ligustrum lucidum*

The dense understorey of weeds is inhibiting natural recruitment of canopy species with the exception of *Casuarina glauca*, of which several individual seedlings were observed on the lower embankment. The Lantana provides avifauna habitat and several nesting sites were observed. It is not advisable to remove the Lantana all at once, rather a staged mosaic approach is recommended.

Privet species is not classified as a noxious weed along the embankment. It should be frilled and left in place, with follow-up spraying and removal of seedlings is necessary. Frilled Privet is known to germinate as densely as 600 seedlings per square meter (Buchanan, 1996).

If regeneration in areas where weeds have been removed is poor, supplementary plantings will be required. Species will be selected from the list provided in **Attachment A**.

Downstream embankment

The downstream section is characterised by a thin strip of vegetation along the embankment. On the bend itself, the vegetation has been invaded by Large Leaf Privet, Camphor laurel (*Cinnamomum camphori)* and Lantana. The rest of the embankment is dominated by *Casuarina glauca* with varying degrees of Lantana and Privet invasion.

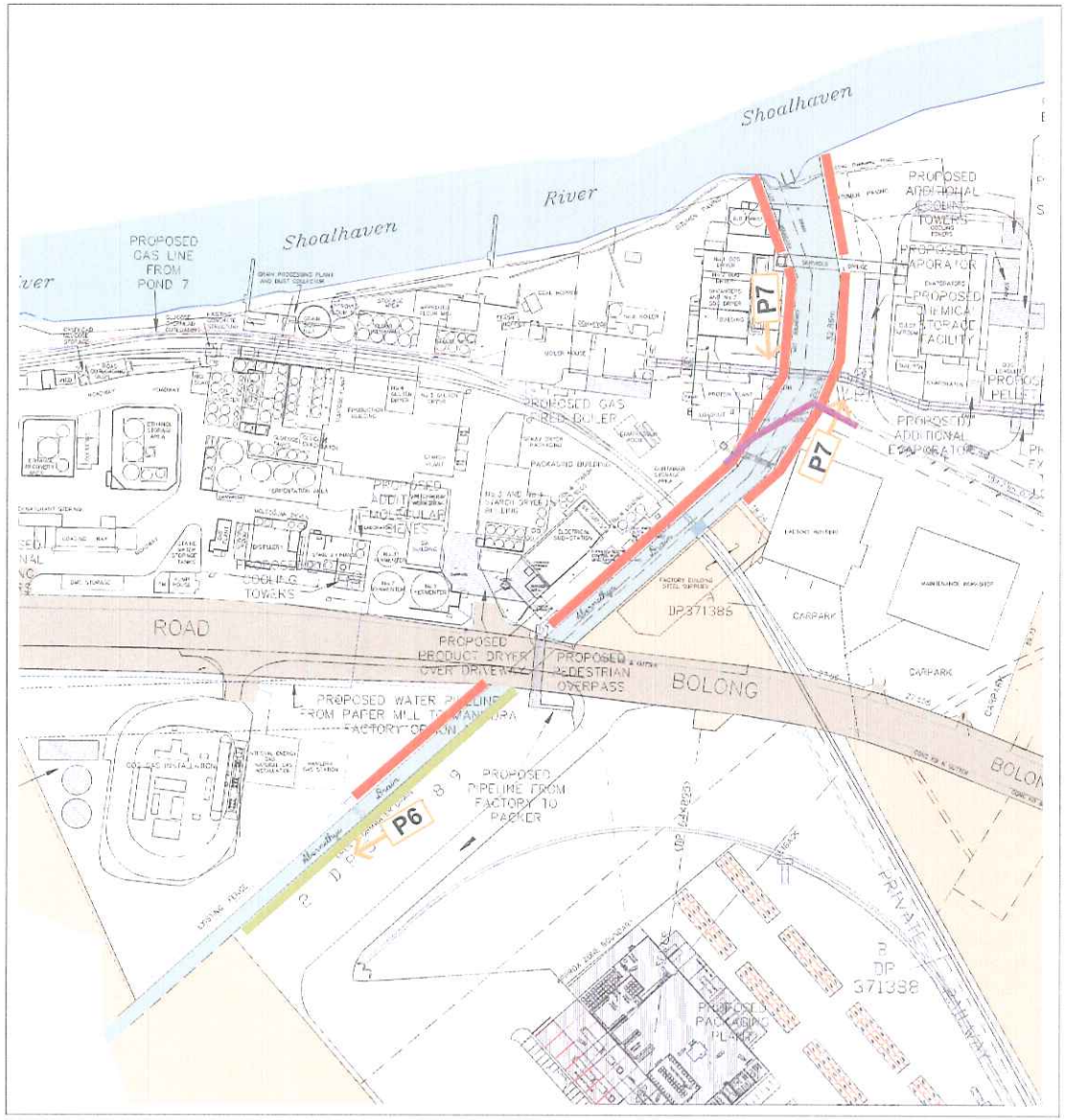
It is recommended that the Privet and Lantana be removed using the same methods as described above. Continuous suppression of noxious weeds in this area will be required so spread is contained.

4.3 Zone C

No Zone C management areas have been identified for Bomaderry Creek.

Abernethy’s Creek

Abernethy's Creek Management Zones



N

LEGEND

- Zone A
- Zone B
- P10 Plate perspective
- Electrical easement

0 50 100

Scale

Site drawings sourced from Allen Price and Associates

Abernethy's Creek passes through the factory site before it converges with Shoalhaven River. It has been previously dredged and channelled and now resembles an open drain, with hardened sections within the factory site. Bank heights range between 1-3m.

Abernethy's Creek has been significantly modified in the past as a flood mitigation measure and in more recent years to increase the angle and promote rapid stream flow from Shoalhaven Council's waste treatment plant to Shoalhaven River. Shoalhaven City Council recently authorised the removal of a section of riparian vegetation, North of Bolong Road, to access the creek and carry out drain cleaning operations. Consequently, the bank has been undercut along the water surface due to the lack of a binding root structure.

5.1 Zone A

The riparian zone along the western side of Abernethy's Creek immediately north of Bolong Road has been identified as a Zone A management area. The western bank was cleared by Shoalhaven City Council approximately 18 months ago (**Plate 6**). Currently the vegetation is dominated by Kikuyu grass and other introduced pasture grasses, and regenerating *Acacia mearnsii* along the embankment. The management objective is to revegetate the bank and assist with the restoration of a structural and floristically diverse riparian zone. The following management measures are recommended:

- Slashing and spraying Kikuyu grass at the rear of the bank to reduce competition
- Plant out the rear of the bank using the full list of species provided in **Attachment A** – the majority of the planting should be Eucalyptus, Casuarinas and *Ficus rubiginosa* as these species have deep roots

Note: it is recommended that new plantings be completed in 'clumps' spaced 5-10m apart, as this will allow Shoalhaven City Council access to the creek for any future de-snagging or drain cleaning

- Spot spray Kikuyu grass (50cm diameter) from the top of the bank to the water's edge
- Plant the top of the bank *Melaleuca ericifolia* and other listed species
- Plant groundcover species such as *Lomandra longifolia* and *Dianella spp.* to reduce weed invasion and soil erosion

5.2 Zone B

Three areas have been identified as Zone B management areas:

- The eastern bank on the northern side of Bolong Road extending up to the footbridge (approximately 70m)
- The embankment south of Bolong Road extending to the overhead electrical easement
- The embankment from the electrical easement extending south to the floodgate opening at Shoalhaven River

North of Bolong Road to footbridge

Vegetation along the embankment is dominated by Lantana and Large leaf Privet. These weed species will be removed and suppressed to allow regeneration of more resilient riparian vegetation.

The foreshore of Abernethy's Creek is considered to be in an 'urban zone' and therefore Privet species are a class 4 noxious weed (**Plate 7**). Consequently greater effort to control and eradicate Privet from Abernethy's Creek is required.

Lantana is to be removed using a staged mosaic approach. Large Leaf Privet will be frilled and left in place, with follow-up spraying and removal of frilled Privet as required. If regeneration is poor, supplementary plantings will be required. Species to be planted should be the same as the recommendations provided for the western embankment in the previous section (Section 5.1 Zone A).

South of Bolong Road to electrical easement

The vegetation in this area is characterised by mature Brush box (*Lophostemon confertus)* with a scattered understorey of Lantana and other weeds. Management measures for this area should involve:

- Spraying weeds on the embankment
- Planting dense growing or tufted perennials such has *Lomandra longifolia*, *Dianella spp.* or *Poa labillardieri*
- Planting a dense line of *Lomandra longifolia* along the top of the bank to reduce sediment transportation

Electrical easement to floodgate

The vegetation in this area is of moderate diversity along its western bank, but poor diversity and no canopy on the eastern bank.

Madeira vine (*Anredra cordifolia*) has infested the southern corner of the east bank and most of the western bank (**Plate 7**). This weed is difficult to control as it twines into the canopy and readily develop s vegetative tubers which drop into the soil. These tubers can be dug up manually or sprayed with Glyphosate in spring and autumn when the plant is actively growing.

The following management measures for this area are recommended:

- Weed suppression for targeted environmental weeds along both banks, in particular infestations of Large and Small leaf Privet
- Planting the eastern side with *Melaleuca ericifolia* and a selection of understorey species down to the water's edge
- Planting the western bank with *Melaleuca ericifolia* and a selection of understorey species once weed suppression have reduced to minor routine maintenance

5.3 Zone C

No Zone C management areas have been identified for Abernethy's Creek.

Broughton Creek

Broughton Creek Management Zones

Broughton Creek forms the eastern boundary of the Farm over a distance of ~3.6km. Broughton Creek has the typical characteristics of an active meandering stream in alluvial floodplain, with evidence of deposits and scouring within the stream network. Bank heights range between 0-3m.

Riparian vegetation varies greatly along the foreshore. Several areas contain excellent examples of structural and floristically diverse floodplain forest vegetation and have been protected since 1997. Notwithstanding, large areas did not have a functional canopy or midstorey and would therefore be susceptible to bank failure.

6.1 Zone A

The majority of the foreshore of Broughton Creek is open grassland with moderate to steep embankments up to 2m in height. Fluvial scour on the long bends, where overstorey and midstorey vegetation is sparse, is evidenced by bank slumping and undercutting. Several areas require revegetation to improve soil cohesion and bank stability and have therefore been identified as Zone A management areas (refer to the map provided at the start of this section), including:

- Stock refuge at the western end of the farm
- Mangrove plantings along the waterline

Permanent fences are in place along most of the foreshore, with the exception of the stock refuge area at the most western extent of the farm boundary. The distance of the fence from the waterline varies from between 10m to over 40m.

Stock flood refuge

The stock refuge area at the western end of the farm foreshore is unfenced and slightly elevated. It is the only area available for stock during flood events. Vegetation is dominated by Kikuyu grass with a few plantings of native trees (0-5 years) along the top of the bank. Bank slumping was observed in this area in 2008 (**Plate 8**).

Given there are no other areas on the farm available as flood refuges, it is recommended that a strip of approximately 3m from the top of the bank be revegetated to improve bank stability. This would involve:

- Slashing Kikuyu grass and spraying with Glyphosate or similar to within 2m of the water's edge
- Spot spraying Kikuyu grass (0.5m diameter) within 2m of the water's edge
- Planting suitable canopy and midstorey species at the rear of the bank (no less than 2m from the water's edge)
- Scattered planting of *Casuarina glauca* and *Myoporum acuminatum* on the bank (but not the water's edge)

As the plants develop, Kikuyu grass will be shaded out and at this time (approximately 2-3 years) and planting out the rest of the bank and along the waterline with suitable species is recommended.

During flood events, a temporary fence line (electric wire) should be erected to protect the seedlings for being trampled or eaten.

Mangrove plantings

Two areas have been identified as suitable for planting mangroves along the waterline. These areas have sandy depositions suitable for planting mangroves. Previous attempts to establish mangroves and have been undertaken along the bank. **Plate 9** shows several individuals that have successfully established.

Prior to any planting, it is recommended that canopy and midstorey species be planted to establish a healthy riparian zone. Once vegetation on the bank and at the rear of the bank has successfully developed and is shading out Kikuyu grass and providing adequate soil cohesion, Grey Mangroves (*Avicennia marina)*, should be planted along the water's edge.

6.2 Zone B

Several areas require revegetation to improve riparian health and bank stability and have therefore been identified as Zone B management areas. These areas include:

- Embankments denuded of a functional canopy and/or midstorey
- Areas where Kikuyu grass quickly transition to floodplain forests

Embankments denuded of a functional canopy and/or midstorey

Several areas along the embankment do not have a functional canopy and/or midstorey capable of providing bank cohesion and stability. These areas are prone to slumping and undercutting. To improve bank stability it is recommended that these areas be planted out with native species from 1m inside the permanent fence to 2m bank from the water's edge.

Plantings will be carried out in stages over several growing seasons to a) increase the likelihood of successful establishment (particularly along the water edge where previous plantings have failed) and b) to spread the costs associated with planting out larger tracts of land. The first stage will involve:

- Slashing Kikuyu grass and spraying with Glyphosate or similar to within 2m of the water's edge
- Spot spraying Kikuyu grass (0.5m diameter) within 2m of the water's edge
- Planting suitable canopy and midstorey species at the rear of the bank (no less than 2m from the water's edge)
- Scattered planting of *Casuarina glauca* and *Myoporum acuminatum* on the bank (but not the water's edge)

Once the new plants from the Stage 1 have successfully established and shaded out Kikuyu grass on the bank and the waterline (approximately 2-3 years), the second stage of plantings is to be carried out:

- Spot spraying any remaining Kikuyu grass on the bank
- Planting suitable midstorey species on the bank to fill out the Stage 1 planting
- Planting suitable species along the water's edge if there is sufficient sandy deposition for the plants to establish

Transition areas

Areas where Kikuyu grass quickly transition to floodplain forests (**Plate 8**) have been identified as Zone B management areas. These areas would benefit from the removal of Kikuyu grass and other introduced pasture weeds at the transition zone, and planting out with suitable rear of the bank species.

Being able to complete this work will be dependent on the width of the bank available from the transition zone to the fence-line. The fence was installed by farm management under a productivity grant to restrict stock grazing in riparian areas. At this stage, further extension is not a priority.

6.3 Zone C

Several areas have been identified as Zone C management areas. The vegetation in these areas exhibit moderate to good structural and floristic diversity, including floodplain forests with mature *Melaleuca styphelioides*. Weed infestations are low and the canopy is intact. These areas have been protected since 1997.

To ensure these areas remain healthy and resilient, visual inspections at the transition between Kikuyu grass and floodplain forests for potential weed infestations on a quaterly basis should be carried out as part of routine farm maintenance. The next section outlines procedures visual inspections of weed infestations.

7 PROCEDURES

7.1 Planting

Season

Unlike other parts of NSW, rainfall in the Shoalhaven Floodplain consistently exceeds evaporation leading to regular inundation and soil saturation. As such no recommendations as to the season for new plantings have been made in this report. Manildra personnel and their contracts should check the weather forecast regularly to identify the best time for planting. It is advisable that plantings are avoided during peak flood periods.

Plants

Forestry tubestock or potted seedlings is recommended (150mm high by 50mm square pot), particularly for screen plantings and along riparian areas where Kikuyu grass is present. The small but semi-advanced plants require minimal preparation before planting and will have a greater success rate where Kikuyu grass is competing for space (e.g. embankment of Broughton Creek). Potted seedlings are an adequate alternative, however may be more expensive.

Ground preparation

Where possible tyne ripping to 0.5m, or digging, will break up sub-soils and improve the establishment time for deep root systems. This will be particularly useful for plantings at the rear of the bank along parts of Shoalhaven River, Bomaderry Creek and Broughton Creek, where the machine has access.

Prior to plantings in areas where long Kikuyu grass is present, grass should be slashed or whipper-snipped and spot sprayed with glyphosate to clear space for the planting.

Density

Recommended densities for new plantings are provided in **Table 4,** unless specifically referred to in the text of this document. It should be noted that as individual plants complete for nutrients, space and light, plant mortality will occur until planted areas develop and the stratum begins to emulate vegetation native to the area. A greater density in the early stages of development is required to shade out introduced grasses and other weed species and allow natural succession to take place.

Table 4: Planting densities

STRATUM	DENSITY & SPACING
Canopy	2 plants per 10m^2 plot
Midstorey shrubs (1-5m)	3 plants per 10m^2 plot
Midstorey shrubs (<1m)	3 plants per 10m^2 plot
Ground layer (grasses & forbs)	Fill in gaps, where appropriate

7.2 Maintenance

Watering

Given the high rainfall experienced in the Shoalhaven area, the requirement for a watering regime is not likely to be necessary. However, during the first six weeks of planting, new seedlings will require watering on a fortnightly basis as a minimum. If the forecast rainfall is not sufficient to meet this, it is recommended that manual watering be implemented. During hot dry and windy periods, failure to water new plantings may result in high plant mortality and the need to replant with new tubestock / seedlings.

Mulch

A minimum of 10cm of mulch such as leaf mould or bark chips (whichever is available) should be spread around newly planted areas. Mulch helps retain soil moisture in the soil and reduces the re-establishment of weed species and perennial grasses, and can therefore reduce the amount time and costs associated with post planting maintenance.

Weed control

Weed control in newly planted areas will largely target a range of noxious and environmental weeds and perennial grasses. Spot spraying is recommended at monthly intervals for the first three months so new plants can successfully become established. A broad spectrum herbicide will be adequate to undertake the task so long as it is used at the manufacturer's recommended dosages for target weeds.

After three months, a visual inspection of weed control measures is to be undertaken to determine when, or if, the next round of weed control is required (weed monitoring procedures are provided in the following section). If the plants have established sufficiently that they are no longer at threat from weeds or perennial grasses, weed control measures can be reduced to a quarterly basis. After one year, further review will be required to determine the effectiveness of weed control measures.

A weed map has been provided at the start of Section 8 Weed Management. This map is also provided in electronic format so Manildra personnel can add information regarding the spread and intensity of weed infestations onsite on a continual basis.

Fauna Impacts

Kevin Mills Associates (2008) conducted a flora and fauna survey of the factory and farm and found the factory has limited habitat opportunities for native fauna. The riparian zone along Broughton Creek on the farm does provide habitat and landscape connectivity for fauna, in particular bird species, with structurally diverse vegetation in some areas and several mature hollow bearing trees.

During the site visit, it was found that some of the larges infestations of Lantana along the Shoalhaven and Bomaderry Creek foreshore provide nesting opportunities for birds. As such it is recommended these infestations be removed using the mosaic technique as this will progressively remove the plant and allow birds species to relocate more readily as habitat is reduced.

On the farm, diverse vegetation will continue to be protected and managed, with a view to extend vegetation in transition areas. As habitat becomes available and diversifies, it is anticipated that native fauna will progressively move into these areas.

Non-native species such as rats and hares were observed at the farm and currently Manildra operate a regular baiting program. Impacts on new plantings are not anticipated, however, if there is evidence of fauna impacts, tree guards should be employed for the first six months after planting.

Stock management on the farm is discussed in the following section.

Access

Access should be restricted in areas where new plantings have been completed until the plants are sufficiently established.

On the farm, the majority of the foreshore has been fenced, with only one section remaining unfenced and utilised as a flood refuge for stock. The stock refuge has been identified as an area at risk of bank failure and will require remediation plantings to improve bank stability. After planting, it is recommended that temporary fencing be installed 3m behind the bank to protect the plants from being eaten or trampled when in use. The remainder of the rear of the bank will continue to be used as a flood refuge.

On the factory site, new screen plantings and riparian enhancement plantings close to vehicle and/or foot traffic should be clearly marked out with temporary barriers or hazard tape where appropriate and security of the plants in assured. Plantings carried out behind any existing fence (e.g. between the Shoalhaven foreshore and the chain link fence) will not need to be marked out unless personnel or visitors frequent the area.

7.3 Monitoring

This section outlines procedures for the visual inspection of newly planted areas and weed infestations. Visual inspections will be carried out to ensure the success of new plantings, and to assess the extent of weeds infestations and the success of weed suppression measures. The frequency of monitoring will depend on the 'Zone' of the area.

To monitor the success of new plantings, the visual inspection will focus on indicators of plant health and mortality. The following table outlines some the typical management measures to overcome adverse health issues.

Table 5: Typical vegetation health management measures

HEALTH INDICATOR	CAUSE	MEASURES
Discolouration e.g. chlorosis, necrosis, reddening	▪ Nutrient deficiency ▪ Water stress ▪ Acidic soils	▪ Application of fertilisers ▪ Regular watering during dry periods ▪ Application of lime
Browsing damage	▪ Native browsers ▪ Introduced mammals ▪ Insects	▪ Guards on young plants to prevent mammal browsing ▪ Pesticides to reduce insect browsing
Infection e.g. spotting, mould	Folia & stem attack Poor genetic stock	▪ Pesticides to reduce pathogen infections

To monitor the success of eradication measures, the visual inspection will focus on whether the weeds remain absent from the site or are re-emergent. Where weeds have been contained, a photo is to be taken at each monitoring event and compared with the previous year's photo to determine whether the weed remains contained or new growth has occurred.

After each monitoring event, areas where further weed suppression is needed will be identified. Priority should be given to managing target weeds (noxious weeds, or weeds that threaten the ecological viability of healthy vegetation communities' onsite) in the first instance, and be in accordance with the management objectives of the *Noxious Weeds Act 1993* (refer to **Section 8.1**)

Visual assessment procedures are provided in **Tables 6-7** on the following page.

Table 6: Visual inspection of new plantings

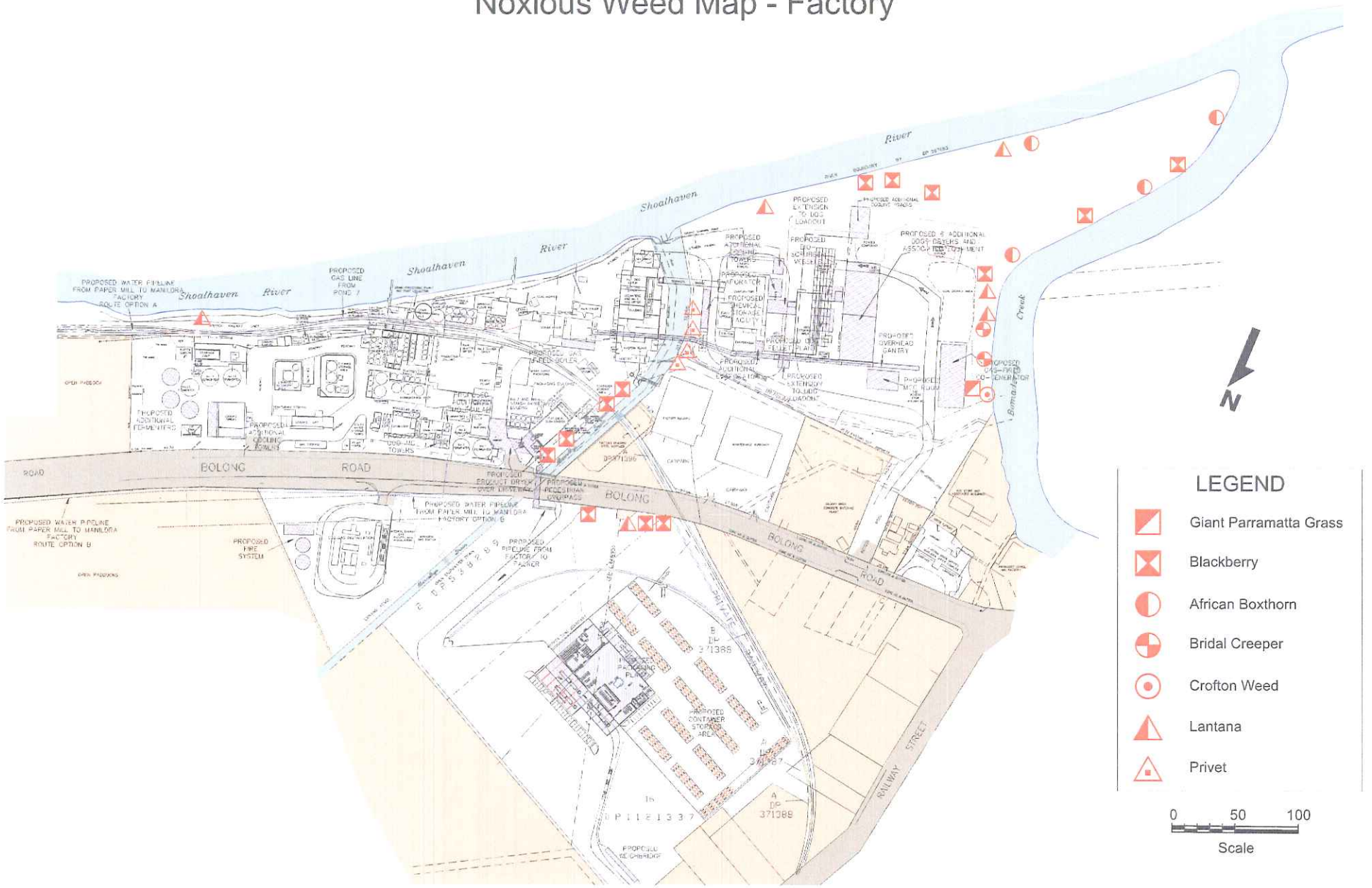
FREQUENCY		SEASON	PROCEDURES
Quarterly	Year 1	Early summer, autumn, winter & spring	1. Visually assess new plantings for indications of: ▪ Discoloration ▪ Plants with browsing damage (mammal and insect) ▪ Infection ▪ Presence of new / flush growth 2. Note any additional information peculiar or unique to the plants 3. Identify appropriate management strategies to ensure ongoing success
Annually	Year 2-5	Early winter	

Table 7: Visual inspection of weeds suppression / re-emergence

ZONE	FREQUENCY		SEASON	PROCEDURES
A	6 & 12 Months	Year 1-2	Early summer & winter	1. Where weeds have been eradicated, visually assess if weeds are 're-emergent' or 'remain absent' 2. Mark re-emergent weeds on the weed map 3. Where weeds are contained, take photos and compare with previous years to determine spread / contraction 4. Note any additional information peculiar or unique to weed area 5. Identify appropriate weed management strategies
	Annually	Onwards	Early winter	
B	6 & 12 months	Year 1	Early summer & winter	
	Annually	Onwards	Early winter	
C	Annually	Onwards	Early winter	

Weeds

Noxious Weed Map - Factory



Site drawings sourced from Allen Price and Associates

8.1 Target weeds

A variety of weed species have been identified in riparian zones of the four watercourses. Weed suppression measures are to target weed species listed under Class 3, 4, and 5 of the *Noxious Weeds Act (NWA) 1993* that apply to a) Shoalhaven City Council area, and b) the whole of NSW.

Class 3 – Regionally Controlled Weeds

Reduce the area and the impact of those plants in parts of NSW

Class 4 – Locally Controlled Weeds

Minimise the negative impact of those plants on the economy, community or environment of NSW

Class 5 – Restricted Plants

Prevent the introduction of those plants into NSW, the spread of those plants within NSW or from NSW to another jurisdiction

Table 8 outlines the weed species to be targeted as part of this plan, and the classification status of those species.

Table 8: LVMP target weed species

SPECIES	CLASS	NWA 1993 MANAGEMENT OBJECTIVES
Giant Parramatta Grass *Sporobolus africanus*	3	*The plant must be fully and continuously suppressed and destroyed*
African Boxthorn *Lycium ferocissimum*	4	*The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority*
Crofton Weed *Ageratina adenophora*	4	
Lantana *Lantana camara*	4*	
Large Leaf Privet *Ligustrum lucidum*	4^	*The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed*
Small Leaf Privet *Ligustrum sinense*	4^	
Blackberry *Rubus fruticosus*	4	
Lantana *Lantana camara*	5	*The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with*
Bridal Creeper *Asparagus asparagoides*	5	

Source: Shoalhaven City Council Weed Control Class 4 Management Plans

** Lantana is only classified as Class 4 when a group of landholders join together to target the species for eradication, otherwise it is classified as Class 5.*

^ Privet species are classified as Class 4 in urban areas only otherwise it is classified as Class 5. Privet observed along Abernethy's Creek is the only place onsite that the species is considered Class 4

8.2 Suppression methods

The resources listed in this section outline detailed best practice guidelines for the eradication and control of noxious and environmental weeds found onsite. These resources are provided in the library for easy reference.

- The Noxious and Environmental Weed Handbook: a guide to weed control in non-crop, aquatic and bushland situations (DPI, 2007), hard copies available from Department of Primary Industries or PDF online at:

  http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0017/123317/noxious-and-environmental-weed-control-handbook-3rd-edn.pdf
- Weed management in riparian areas: south-eastern Australia (CRC Weed Management, 2008)
- Best Practice Management Guide: General guidelines (CRC Weed Management, 2002)
- Manual weed suppression techniques
- Weed Management Guide: African Boxthorn (*Lycium ferocissimum*) (CRC Weed Management, 2007)
- Weed Management Guide: Bridal Creeper (*Asparagus asparagoides*) (NHT, 2003)
- Weed Management Guide: Blackberry (*Rubus fruticosus*) (CRC Weed Management, 2003)
- Agnote: Control of Giant Parramatta Grass (NSW Agriculture, 2001)
- Weed Management Guide: Lantana (*Lantana camara*) (CRC Weed Management, 2000)

The Noxious and Environmental Weed Handbook includes an alphabetised list of weed species and their eradication and control measures from page 30 onwards.

Relevant personnel (i.e. Shoalhaven Starches Management and contractors) are to reference these resources to ensure best practice measures are implemented onsite.

Weed eradication and/or control measures are not to commence until adequate funding for the program from commencement to completion is secured or guaranteed. A strategic approach would take into consideration works completed by other local organisations, particularly near boundary areas, and the availability of local, State and Federal funding grants.

9 SUPPLIERS

Table 9 outlines the some of the suppliers in the area for the provision of materials, and bush revegetation and landscaping expertise. This list is not exhaustive of the resources available in the area.

Table 9: Preferred suppliers list

SERVICES	NAME	ADDRESS	CONTACT DETAILS
Seedlings, landscape plantings, bush regeneration	Jamberoo Native Nursery	127 Curramore Rd, Jamberoo NSW	Ph: 02 4236 0445 Fax: 02 4236 0621 sales@jamberoonatives.com.au
Weed suppression, landscape plantings, bush regeneration	Enviroquest Landscape Management	Po Box 599, Nowra 2541	Ph: 1300 852 393 info@enviroquest.com.au
Bush regeneration & ecological restoration	Proust Bushland Services	PO Box 1077, Tomerong NSW	Ph: 02 4443 6537 pbs@shoalhaven.net.au
Bush regeneration	Conservation Volunteers	Cnr Cliff Rd & Harbour St, Wollongong NSW	Ph: 02 4228 9246
Mulch, soil, compost, spreading services	Soilco	Wogamia Rd, West Nowra NSW	Ph: 02 4422 9944
Mulch, fertilisers, herbicides, tree guards, stakes & edging	All Stake Supply	60 Prices St, Riverstone NSW	Ph: 1300 130 123 info@allstakesupply.com.au
Mulch & tree/stump removal	A&D Tree Services	L33, 1 Central Avenue, South Nowra NSW	Ph: 02 4423 6555 M: 0418 428 824
Mulch & tree/stump removal	Caldman Pty Ltd Tree Services	PO Box 88, Nowra NSW	Ph: 02 4421 4626 M: 0418 447907
Mulch	Shoalhaven Recycling	10 Victa Way, Bomaderry NSW	Ph: 02 4421 4597

1 SUMMARY OF ACTIONS

Table 11 has been developed as a quick reference for the priorities and actions outlined in this plan. The implementation of the plan will be undertaken over two phases. It is anticipated that each phase will take approximately 1-3 years to complete from the commencement of works. Monitoring and maintenance measures are detailed in **Section 7** (**Tables 7-9**) and have not been included in this summary table.

Table 11: Summary of actions, including a schedule of implementation

ASPECT / FORESHORE	MANAGEMENT ZONE	AREA	ACTIONS	IMPLEMENTATION SCHEDULE	REFERENCE
Phase 1					
Landscaping	-	Fermenters	▪ Plant *Casuarina Glauca* at 1.5m spacing to screen fermenters	On completion of construction works	Section 2
		Packaging plant	▪ Remove weeds and plant Melaleuca, Eucalyptus and Casuarina species between packaging plant and Bolong Rd	On completion of construction works	Section 2
Shoalhaven River	Zone A	Emergency revetment	▪ Removal immature coral trees from revetment and adjacent area ▪ Complete revegetation of revetment IAW landscaping plan (**Appendix B**)	Commence immediately	Section 3.1
			▪ Plant fast growing *Casuarina glauca* at rear of revetment ▪ Plant Eucalyptus and Melaleuca canopy species, and Lomandra as a groundcover at rear of revetment	On completion of construction works at flour mill	Section 3.1
		Confluence Shoalhaven River and Bomaderry Creek to 10m behind the bank	▪ Slash and spray Kikuyu grass ▪ Eradicate African Boxthorn and remove Lantana ▪ Plant out waterline with Grey Mangroves and Juncas Krausii ▪ Plant fast growing native species at the top of the bank and canopy species at the rear of the bank, and fill in with groundcovers	Commence within 6 months of plan approval	Section 3.1
Bomaderry Creek	Zone A	Confluence with Shoalhaven River to 250m upstream	▪ Slash and spray Kikuyu grass ▪ Plant top of bank with canopy species and midstorey species ▪ Fill in with groundcovers	Commence within 6 months of plan approval	Section 4.1
Abernethy's Creek	Zone A	Western bank, north of Bolong Rd	▪ Slash and spray Kikuyu grass ▪ Plant full list of riparian species at rear of bank ▪ Plant top of bank with *Melaleuca erificifolia* and other listed species ▪ Fill in the Lomandra and *Dianella spp.*	Commence within 6 months of plan approval	Section 5.1

Broughton Creek	Zone A	Stock flood refuge area to 10m behind bank	▪ Slash and spray Kikuyu grass ▪ Plant canopy and midstorey species at rear of bank ▪ Plant scattered *Casuarina glauca* and *Myoporum acuminatum* on bank (but not the waterline) ▪ Erect temporary barriers when area is used as flood refuge	Commence within 6 months of plan approval	Section 6.1
		Embankments with no canopy or midstorey	▪ Slash and spray Kikuyu grass ▪ Plant canopy and midstorey species at rear of bank ▪ Plant scattered *Casuarina glauca* and *Myoporum acuminatum* on bank (but not the waterline)	Commence within 6 months of plan approval	Section 6.1

Phase 2

Shoalhaven River	Zone B	Dense area of Acacia mearnsii	▪ Clear 10m x 10m plots and replant with other canopy species at 2m spacing ▪ Remove acacia seedlings and monitor success of plantings	Commence within 3 years of plan approval	Section 3.2
		Grassy area behind crib shed	▪ Whipper-snip and spray Kikuyu grass ▪ Plant toe with water line species ▪ Plant canopy and midstorey species at top of bank ▪ Fill in with groundcovers	Commence within 3 years of plan approval	Section 3.2
	Zone C	Eastern boundary to revetment	▪ Spray lantana ▪ Plant out with groundcover species (Lomandra)	Commence within 3 years of plan approval	Section 3.3
		West of Abernethy's outflow	▪ Remove lantana using mosaic approach ▪ Suppress African Boxthorn and Blackberry	Commence within 3 years of plan approval	Section 3.3
	Unzoned	Between crib shed and revetment	▪ Geotechnical assessment of bank stability to assess potential of removing Coral trees from bank	Within 5 years of plan approval	Section 3.4
Bomaderry Creek	Zone B	Upstream and downstream embankment	▪ Remove Lantana using mosaic approach ▪ Eradicate African boxthorn and Blackberry ▪ Frill privet	Commence within 3 years of plan approval	Section 4.2
Abernethy's Creek	Zone B	Eastern bank, north of Bolong Rd	▪ Remove Lantana using mosaic approach ▪ Assist natural regeneration, or supplementary plantings	Commence within 3 years of plan approval	Section 4.2
		Both banks, south of Bolong Rd to electrical easement	▪ Spray weeds on embankments ▪ Dense plantings of groundcover species	Commence within 3 years of plan approval	Section 4.2
		Both banks, south of electrical easement to outflow	▪ Suppress Privet and spray other weeds ▪ Plant eastern bank with selection of midstorey species	Commence within 3 years of plan approval	Section 4.2

Broughton Creek	Zone A	Stock flood refuge area to 10m behind bank	▪ Plant out waterline with suitable mangrove species	On successful completion of Phase 1 works	Section 6.1
		Embankments with no canopy or midstorey	▪ Plant out waterline with suitable mangrove species	On successful completion of Phase 1 works	Section 6.1
	Zone B	Transition areas	▪ Slash and spray and Kikuyu grass ▪ Plant suitable upper bank canopy and midstorey species	Commence within 5 years of plan approval	Section 6.2

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Plates

Plate 1: Existing screen planting between proposed evaporation columns and Shoalhaven River (container height 2m)

Plate 2: Area proposed for landscape planting to screen new fermenters

Plate 3: Coral trees on revetment and adjacent embankment

Plate 4: Vegetation at confluence of Shoalhaven River and Bomaderry Creek

Plate 5: Shoalhaven River embankment and Crib Room

Plate 6: Embankment of Abernethy's Creek, north of Bolong Rd

Plate 7: Madeira vine and Large leaf privet on the embankment of Abernethy's Creek, South of Bolong Road

Plate 8: Stock flood refuge area at western end of Broughton Creek

Plate 9: Advancing mangroves and phragmites along Broughton Creek (Zone A)

Plate 10: Healthy and representative floodplain forest on Broughton Creek (Zone C)

Attachment A

Species list for riparian enhancement plantings

Attachment A: Species list for riparian enhancement plantings

BANK POSITION	VEGETATION LAYER	SPECIES
Rear of bank	Canopy	Eucalyptus robusta, Eucalyptus botryioides, Eucalyptus saligna x botryioides, Eucalyptus tereticornis, Casuarina glauca, Angophora floribunda, Callistemon viminalis, Melaleuca styphelioides, Melaleuca linariifolia, Alphitonia excelsa, Ficus rubiginosa, Ficus macrophylla, Livistona australis
	Midstorey	Melaleuca ericifolia, Myoporum acuminatum, Rapanea variablis, Glochidion ferdinandi, Omalanthus populifolius, Scalopia braunii, Synoum glandulosum, Acmena smithii, Pittosporum undulatum, Indigofera australis
	Ground layer	Lomandra longifolia, Carex appressa, Dichondra repens, Centella asiatica, Tetragonia tetragonioides, Microlaena stipoides, Einadia hastata, Commelina cyanea, Juncus usitatis, Poa labillardieri
Top of bank	Canopy	Casuarina glauca, Callistemon viminalis, Melaleuca styphelioides, Melaleuca linariifolia, Banksia integrifolia
	Midstorey	Melaleuca ericifolia, Myoporum acuminatum, Pittosporum undulatum, Indigofera australis
	Ground layer	Lomandra longifolia, Carex appressa, Gahnia clarkei, Dichondra repens, Centella asiatica, Tetragonia tetragonioides, Microlaena stipoides, Einadia hastata, Rhagodia candolleana, Commelina cyanea, Juncus kraussii (saltwater), Juncus usitatus (freshwater), Ficinia nodosus, Hibbertia scandens, Poa labillardieri
Water line (if possible)	Canopy	Avicennia marina (High water mark), Aegiceras corniculatum (spring high water mark), Melaleuca ericifolia (freshwater areas), Melaleuca styphelioides, Casuarina glauca
	Midstorey	Melaleuca ericifolia (freshwater areas), Myoporum acuminatum
	Ground layer	Tetragonia tetragonioides, Rhagodia candolleana, Juncus krausii (saltwater), Juncus usitatus (freshwater), Apium prostratum, Triglochin striata, Baumea juncea, Lomandra longifolia, Phragmites australis, Crinum pend-undulatum (Broughton Creek), Bulboschoenus caldwellii (Abernethys), Poa labillardieri

Attachment B

Allison Hunt & Associates (2008) Shoalhaven Starches: landscaping of revetment wall

ALISON HUNT & ASSOCIATES PTY LTD

ABN 76 233 543 751

8 Duncan Street, Arncliffe NSW 2205
Office (02) 9599 0402 Mob. 0408 769 315
alison@ahecology.com

19 June 2008

Mr B Edwards
Beca
PO Box 7079
St Kilda Road VIC 8004

Dear Brendan

Shoalhaven Starches
Landscaping of Revetment Wall

Alison Hunt & Associates Pty Ltd was requested to specify vegetation to be planted in holes in the rock wall and provide a guide to planting. After consultation with a number of sources it is suggested that Swamp Oak be planted mid-height and a number of shrub and herb species included below the mid-height section of the wall. All of these species are extremely hardy, excellent colonisers and will tolerate a range of conditions. A plant schedule is provided in Table 1.

Yours faithfully
Alison Hunt & Associates Pty Ltd

A. Hunt

Dr Alison Hunt
Director

Table 1 Plant Schedule for Vegetation of the Revetment Wall

Species	Description	Position	Planting Guide
New Zealand Spinach (*Tetragonia tetragonioides*)	Prostrate spreading annual or short-lived perennial. Hardy coastal species.	Scattered plantings below mid-height of the revetment wall.	Tubestock should be planted on top of the geotextile fabric between the boulders in good quality soil placed between the boulders. The root zone should be watered well and mulched if possible. Follow up watering should be undertaken until establishment especially if planting is undertaken during a dry spell. Dead plants should be replaced.
Spiny-headed Mat-rush (*Lomandra longifolia*)	A large tufted herb with strap-like leaves up to 1m long. Very hardy.	Scattered plantings below mid-height of the revetment wall.	Tubestock should be planted on top of the geotextile fabric between the boulders in good quality soil placed between the boulders. The root zone should be watered well and mulched if possible. Follow up watering should be undertaken until establishment especially if planting is undertaken during a dry spell. Dead plants should be replaced.
Climbing Guinea Flower (*Hibbertia scandens*)	Salt resistant scrambler with large golden yellow flowers. Often planted near the sea.	Scattered plantings below mid-height of the revetment wall.	Tubestock should be planted on top of the geotextile fabric between the boulders in good quality soil placed between the boulders. The root zone should be watered well and mulched if possible. Follow up watering should be undertaken until establishment especially if planting is undertaken during a dry spell. Dead plants should be replaced.
Pigface (*Carpobrotus glaucescens*).	Prostrate perennial with stems to 2 m long, on coastal sand dunes, usually very close to the sea.	Scattered plantings below mid-height of the revetment wall.	Tubestock should be planted on top of the geotextile fabric between the boulders in good sandy soil placed between the boulders. The root zone should be watered well and mulched if possible. Follow up watering should be undertaken until establishment especially if planting is undertaken during a dry spell. Dead plants should be replaced.
Swamp Oak (*Casuarina glauca*)	Tree 8 – 20 m high, frequently producing root suckers; branchlets drooping. Occurs in brackish situations along coastal streams, somewhat farther inland along major river valleys. Often forming pure stands.	Planted at the mid-height section of the wall.	Obtain seedlings of 5 litre pot size. These should be planted at 10 m centres. A hole in the geotextile fabric should be made and a hole for planting should be dug at least 100% more by volume than the pot size. Plants should be staked if necessary. The root zone should be watered well and mulched if possible. Follow up watering should be undertaken until establishment especially if planting is undertaken during a dry spell. Dead plants should be replaced.

ANNEXURE 3

ANNEXURE 3

Department of Planning's Approval in accordance with Condition 43 of Project Approval MP06_0228 for Landscape Vegetation Management Plan

Copy to. BH
TG.
SRichardson
S Coggs
13/4 MR

NSW GOVERNMENT | Planning

Mr Ming Leung
Site Manager
Shoalhaven Starches Pty Ltd
PO Box 123
NOWRA NSW 2541

Contact: Ann-Maree Carruthers
Phone: (02) 9228 6550
Fax: (02) 9228 6399
Email: Ann-Maree.Carruthers@planning.nsw.gov.au

Our Ref: S06/00616

Dear Mr Leung

Shoalhaven Starches Extension Project
Management Plans

I refer to the various material Shoalhaven Starches has submitted to the Director-General for approval.

I would like to advise you that the Director-General has approved both the Emergency Plan and the Landscape and Vegetation Management Plan (LVMP), subject to the condition that Shoalhaven Starches provide annual reports (in conjunction with its other reporting requirements) to both the Department and NOW on the status of the implementation of the LVMP and associated monitoring results.

However, the Department considers the remaining plans to be deficient (see attached schedule), and I would appreciate it if you would amend and re-submit these plans to the Department by the end of May 2010.

Finally, it has come to the Department's attention that a cover over one of the wastewater treatment lagoons may have become defective in February 2010 creating the potential to release offensive odours. The Department does not appear to have received a report of such an incident in accordance with Schedule 4, Condition 2 of the project approval which requires incidents to be reported as soon as practicable after the Proponent becomes aware of the incident. Please provide a detailed written report on this incident within 7 days, including the date the incident occurred, management measures that were in place to prevent such an incident given the life expectancy of the cover, complaints records for the past three months, and any subsequent action taken.

If you have any enquiries relating to this matter, please contact Ann-Maree Carruthers on 9228 6550.

Yours sincerely

8/4/10

David Kitto
Director
Mining & Industry Projects
as delegate of the Director-General

ANNEXURE 4

Compliance Audit

Landscape Vegetation Management Plan

ANNEXURE 4

COMPLIANCE AUDIT

LANDSCAPE VEGETATION MANAGEMENT PLAN

Condition 43 of the Project Approval for the Shoalhaven Starches Expansion Project (MP06_0228) required the submission and approval of a Vegetation Management Plan (VMP) for the site and for this plan to be approved by the Director-General of Planning.

A Landscape and Vegetation Management Plan (LVMP) prepared by Coffey Environments was submitted to and approved by the Department of Planning in compliance with condition 43 of the Project Approval.

Shoalhaven Starches have made significant progress in terms of vegetation management in accordance with this approved Landscape Vegetation Management Plan

There has been progressive weed removal and eradication along the banks of Bomaderry Creek, the Shoalhaven River and Abernethys Creek as outlined in the LVMP. Given the habitat and soil conservation role that existing weed cover plays, weed removal has been undertaken in a progressive and staged manner to minimise fauna impacts and to reduce the areas of exposed soil at any one time. Weed management and landscaping is being undertaken on an on-going basis

Following weed eradication a planting regime has been undertaken in accordance with the LVMP.

The following table provides a photographic description of landscaping works that have been undertaken in accordance with the LVMP with reference to **Figures 1**, **2** and **3** which are attached and which have been extracted from the LVMP prepared by Coffey Environments. These figures have been annotated with the numbering used in the table below showing the location from where the photographs have been taken.

Bomaderry Creek Management Zones

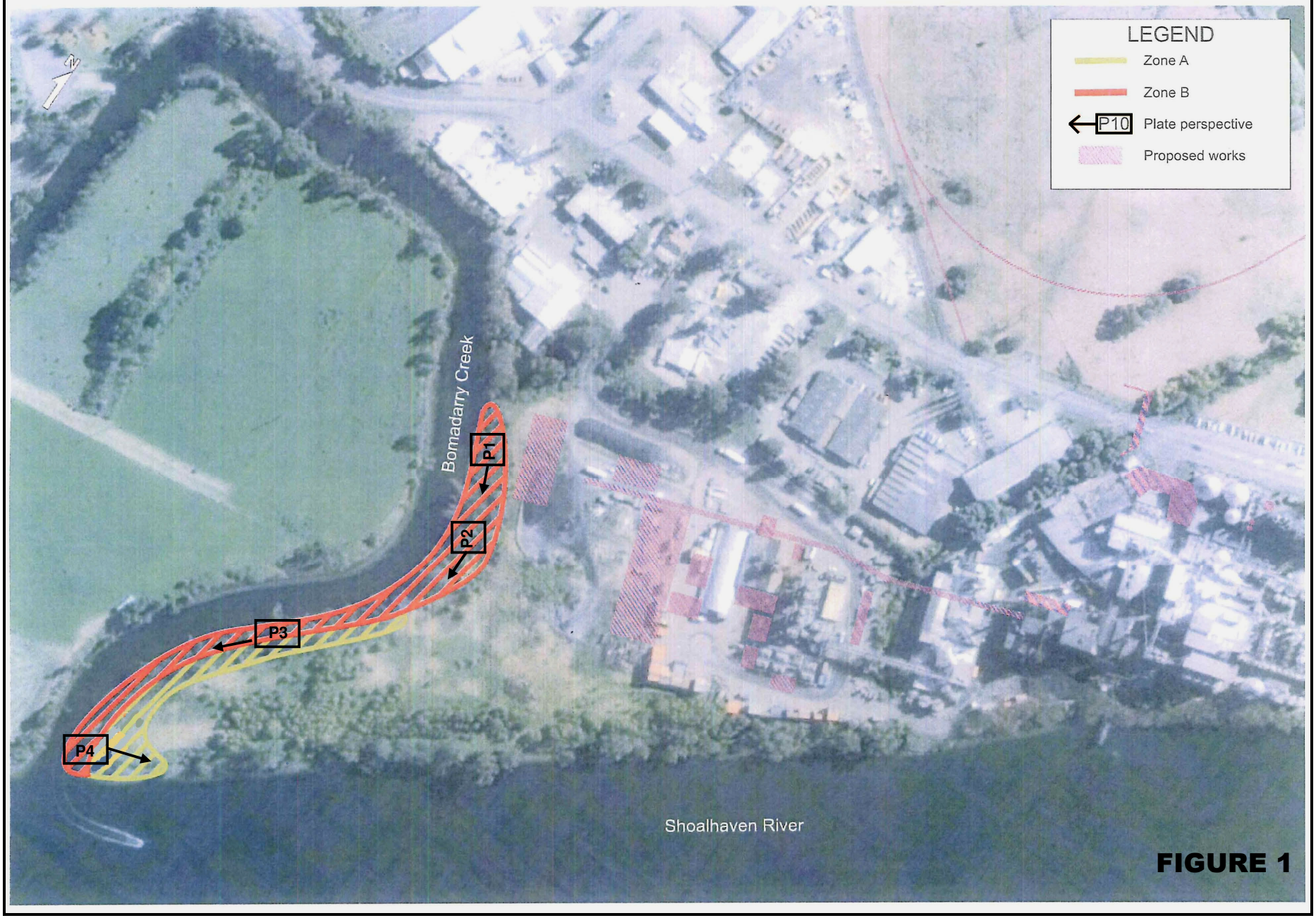


FIGURE 1

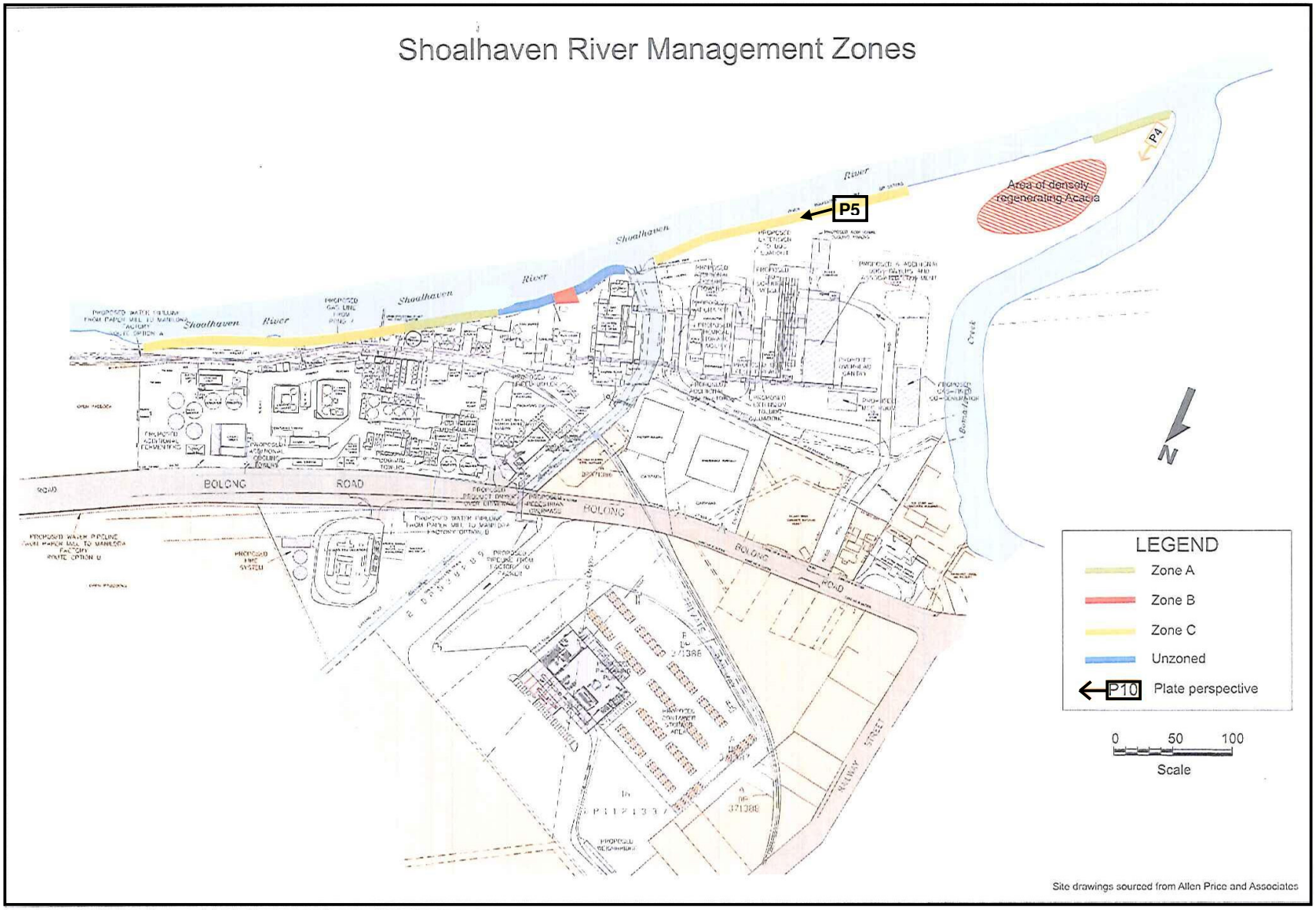
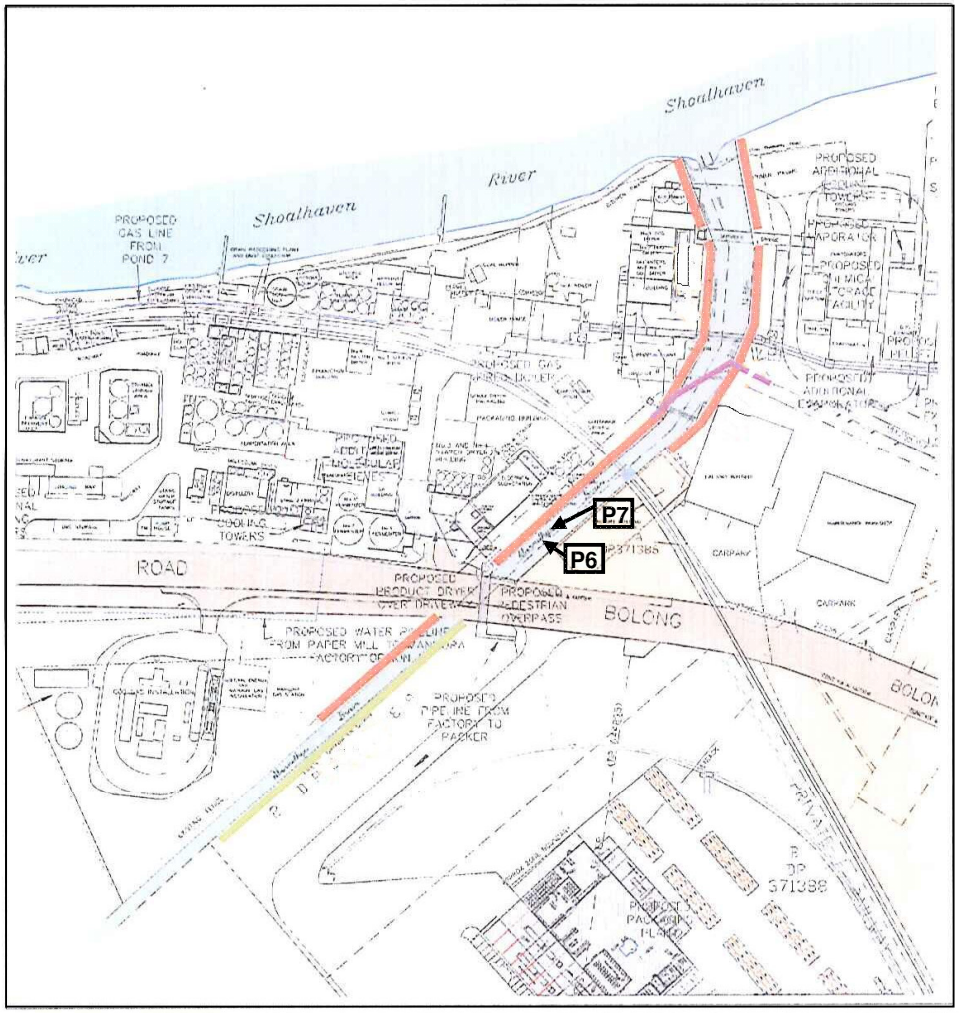

Shoalhaven River Management Zones
P5
P4
Area of densely regenerating Acacia
Shoalhaven River
BOLONG ROAD
LEGEND
Zone A
Zone B
Zone C
Unzoned
P10 Plate perspective
0 50 100
Scale
N
Site drawings sourced from Allen Price and Associates

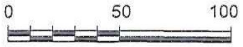
FIGURE 2

Abernethy's Creek Management Zones



LEGEND

- Zone A
- Zone B
- P10 Plate perspective
- Electrical easement



Site drawings sourced from Allon Price and Associates

FIGURE 3

Photograph No. and Map Reference	***Photograph***	***Description***
1		This photograph was taken from immediately adjacent to the western boundary of the factory site with Bomaderry Creek. Weed infestation in this area has been removed and the photograph shows the establishment of new plantings in this area.
2		This photograph was taken further south from Photograph 1 along the western boundary of the factory site with Bomaderry Creek. Weed infestation in this area has been removed and the photograph shows the new plantings in this area.
3		This photograph was taken towards the confluence of Bomaderry Creek and the Shoalhaven River. Extensive weed infestation in this area has been removed and the photograph shows the establishment of new plantings in this area.

Photograph No. and Map Reference	***Photograph***	***Description***
4		This photograph was taken towards to the east of the confluence of Bomaderry Creek and the Shoalhaven River. Extensive weed infestation in this area has also been removed and the photograph shows the establishment of new plantings in this area.
5		This photograph was taken along the banks of the Shoalhaven River. Extensive weed infestation in this area has been removed and the photograph shows the establishment of new plantings supplementing existing forest vegetation in this area.

Photograph No. and Map Reference	***Photograph***	***Description***
6		This photograph was taken along the banks of Abernethys Creek. Extensive weed infestation in this area has been removed and the photograph shows the establishment of new plantings in this area.
7		This photograph was also taken showing the banks of Abernethys Creek. Extensive weed infestation in this area has been removed and the photograph shows the establishment of new plantings in this area

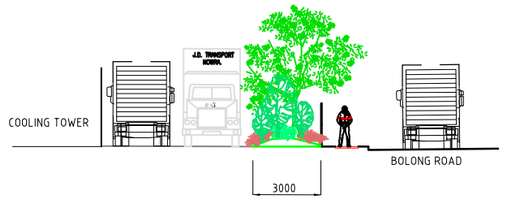
ANNEXURE 5

ANNEXURE 5

Landscape Plan

prepared by

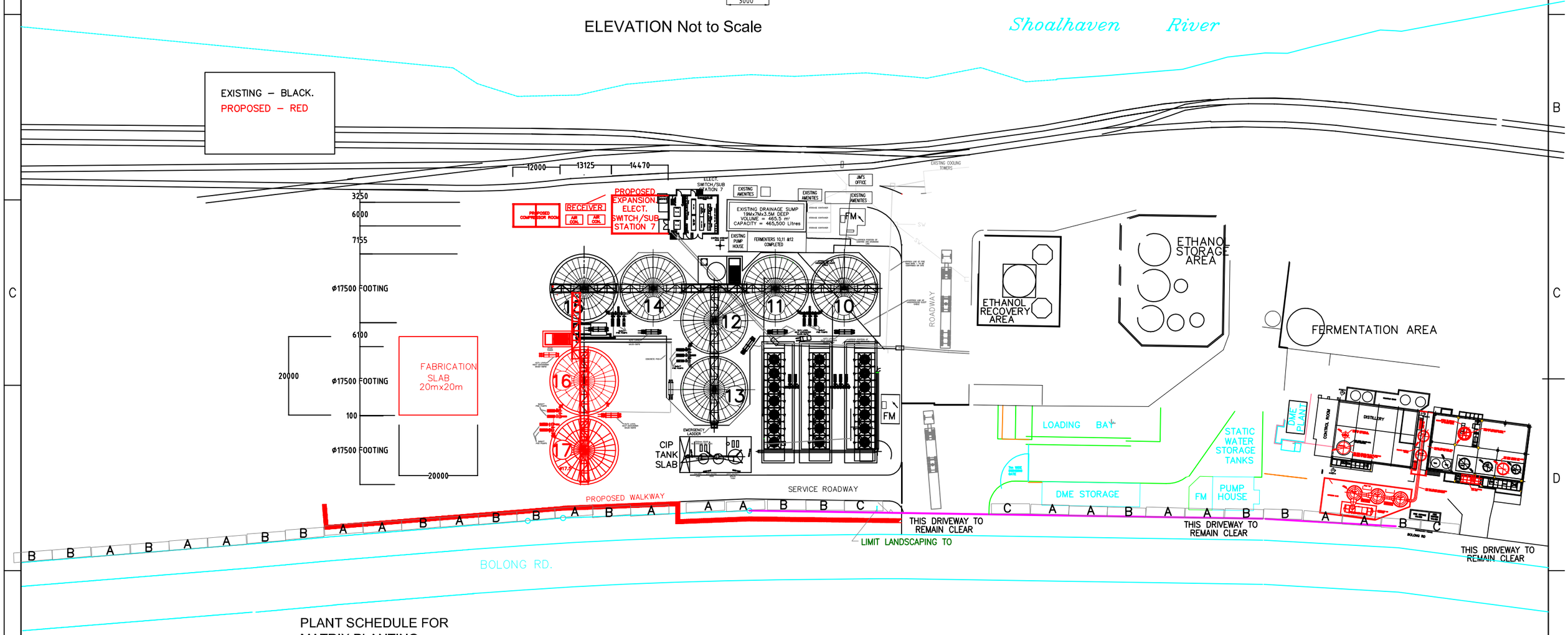
Peter Phillips Landscape Consultant



ELEVATION Not to Scale

Shoalhaven River

EXISTING – BLACK.
PROPOSED – RED



LANDSCAPE PLAN

PLANT SCHEDULE FOR MATRIX PLANTING

Symbol	Name	Name	Size	Pot Size	NO.
TREES					
CC	Callistemon salignus	Callistemon Pink Tips	9mx3m	200mm	71
ER	Elaeocarpus reticulatus	Blueberry Ash	8mx5m	18x75lt;70x200mm	88
HF	Hymenosporum flavum	Native frangipani	15mx8m	45lt	36
LP	Leptospermum petersonII	Lemon Scented Tea Tree	5mx4m	200mm	34
LC	Lophostemon confertus	Brushbox	15mx10m	75lt	52
WF	Waterhousia floribunda	Weeping Lilly Pilly	15mx8m	45lt	34

Symbol	Name	Common Name	Size	Pot Size	NO.
SHRUBS					
ASM	Acmena smithii Minor	Dwarf Lilly Pilly	5mx3m	75mm	69
BE	Banksia ericifolia	Coastal Banksia	5mx5m	"	104
CC	Callistemon citrinus Endeavour	Endeavour Bottlebrush	3mx3m	"	116
CG	Ceratapetalum gummiferum	NSW Christmas Bush	5mx3m	"	38
MH	Melaleuca hypericifolia	Red Flowering Paperbark	4mx2m	"	18
MT	Metrosideros Thomasii	NZ Christmas Bush	8mx4m	"	90
SA	Syzygium australae	Brush Box		"	105

Symbol	Name	Common Name	Size	Pot Size	NO.
GRASSES + GROUNDCOVERS					
DR	Dianella Breeze	Flax Lily	0.5mx0.5m	75mm	411
LL	Lomandra longifolia	Matt Rush	1mx1m	"	261
LT	Lomandra Tanika	Dwarf Mat Rush	.75mx.75m	"	319
MS	Microlena stipoides	Weeping Grass	1mx1m	"	327
PE	Poa Eskdale	BlueTussock Grass	.75mx.75m	"	405

DESIGN NOTES

Landscape contractor must show extreme care in protecting services and works by other contractors. This will include all paths and structures.

MOUNDING OF GARDEN BEDS

Landscape contractor is to allow to install extra soil to provide mounding to the planting bed to a maximum hieght of 400mm. This will provide a medium for good growth.

CULTIVATION OF EXISTING GROUND

Existing ground is to be ripped and cultivated to a depth of 200mm minimum with gypsum to be incorporated.

See specification for rates.

GARDEN EDGING

Timber edging shall be installed along the boundary fence to deter grass invading the planting beds.

ISS	DATE	ZONE	CHANGE AMENDMENTS	BY	CKD
05	05–2012	All	Council Submission	PP	PP

MANILDRA GROUP
100% AUSTRALIAN

TITLE: MANILDRA GROUP.NOWRA
LANDSCAPE SCREEN.
SITE PLAN.

PPLA
Peter Phillips Landscape Architecture
4 BINDON CLOSE BOMADERRY 2541 FAX : 0244221310 MOB : 0410040507

PROJECT : PROPOSED MODIFICATIONS TO FERMENTERS
MANILDRA FACTORY
For : MANILDRA GROUP NOWRA

LANDSCAPE PLAN

SCALE : 1:1000 A3 | DWG. LO1 | Rev : A

DATE : April 2012 | DRAWN : Peter Phillips

54486

5176 | 24412 | 24898

A02214 2

MOLECULAR SIEVES

CONTROL ROOM

DISTILLERY

1 A02214

PUMP TYP

1ST EFF

2ND EFF

ø2946

ø1524

SIDE STRIPPER

NEW SIDE STRIPPER IS PART OF THE RECTIFIER.

OLD BEER COLUMN D10. TO BE REMOVED.

RECTIFIER

ø3050

OLD BEER COLUMN D10 TO BE REMOVED AND NEW RECTIFIER COLUMN TO BE INSTALLED IN SAME LOCATION.

REMOVE EXISTING STAIRS

MODIFY OR REMOVE EXISTING HEAT EXCHANGER AT GROUND LEVEL.

E515

NEW HEAT EXCHANGER H504 IS PART OF NEW BEER COLUMN.

ø3017

REMOVE EXISTING FIRE WALL AND MODIFY FIRE SYSTEM.

ø2200

T660

T680

T501

ø2600

ø2200

T540

NEW BEER COLUMN REPLACES OLD BEER COLUMN D10.

ø2738

ø2200

T801

E10

E662

E814

NEW PLATFORM FOR FAN

CLEAR

NEW FIVE COLUMN EVAPORATOR AND ASSOCIATED EQUIPMENT.

PERIMETER BUND WALL

ø3682

PUMP TYP

4TH EFF

3RD EFF

2ND EFF

CONCRETE SLAB

CONDENSER ON PLATFORM

FIRE SERVICE VALVES

FIRE SERVICE VALVES

PLANT LIST ON L01

MODIFY MATIX PLANTING BY MOVING GROUNDCOVERS AWAY FROM BAYS

A A B C

BOUNDARY FENCE

MODIFY MATIX PLANTING BY MOVING GROUNDCOVERS UNDER TREES

BOLONG RD

DISTILLERY MODIFICATIONS

PROPOSED EQUIPMENT SHOWN IN RED.

SHOALHAVEN STARCHES PTY. LTD.

0 1 2 3 4 5 6 7 8 9 10 METRE

PPLA
Peter Phillips Landscape Architecture

4 BINDON CLOSE BOMADERRY 2541 FAX : 0244221310 MOB : 0410040507

PROJECT : PROPOSED MODIFICATIONS TO DISTILLERY MANILDRA FACTORY
For : MANILDRA GROUP NOWRA

LANDSCAPE PLAN

SCALE : 1:1000 A3 | DWG. LO3 | Rev : A

DATE : April 2012 | DRAWN : Peter Phillips

EXISTING – BLACK.

PROPOSED – RED

Shoalhaven River

12000 13125 14470

PROPOSED COMPRESSOR ROOM

RECEIVER

AIR CON.

AIR CON.

PROPOSED EXPANSION. ELECT. SWITCH/SUB STATION 7

ELECT. SWITCH/SUB STATION 7

EXISTING AMENITIES

EXISTING AMENITIES

EXISTING AMENITIES

JIM'S OFFICE

EXISTING DRAINAGE SUMP
19Mx7Mx3.5M DEEP
VOLUME = 465.5 m³
CAPACITY = 465,500 Litres

STORAGE CONTAINER

STORAGE CONTAINER

STORAGE CONTAINER

FM

EXISTING PUMP HOUSE

FERMENTERS 10,11 &12 COMPLETED

EXISTING HYDRANT RING MAIN

APPROX POSITION OF EXISTING 300 DRAINAGE LINE

EXISTING COOLING TOWERS

SW

SW

APPROX LINE OF FIRE RING MAIN – TO BE CONFIRMED ON SITE

APPROX LINE OF UNDERGROUND ELECT CABLE

APPROX LINE OF UNDERGROUND ELECT CABLE

ROADWAY

15 14 12 11 10

16 13 17

Ø17.5

8x6x17 PWO PUMPS

ALFA LAVAL HEAT EXCHANGER MA30–SMFM

STAIR TOWER

CONCRETE PAD

EMERGENCY LADDER

CIP TANK SLAB

200mm BUND ALL AROUND CIP AREA

CAUSTIC TANK

HOT WATER TANK

FEED WATER / BREAK TANK

SERVICE ROADWAY

PROPOSED WALKWAY

A A B A B B A B A A B B A A B B A C

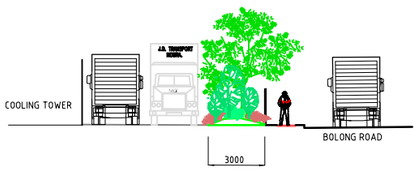
BOLONG RD.

PLANT SCHEDULE FOR MATRIX PLANTING

Symbol	Name	Name	Size	Pot Size	NO.
TREES					
CC	Callistemon sallgnus	Callistemon Pink Tips	9mx3m	200mm	35
ER	Elaeocarpus reticulatus	Blueberry Ash	8mx5m	9x75lt:34x200mm	43
HF	Hymenosporum flavum	Native frangipani	15mx8m	45lt	18
LP	Leptospermum petersonii	Lemon Scented Tea Tree	5mx4m	200mm	16
LC	Lophostemon confertus	Brushbox	15mx10m	75lt	25
WF	Waterhousia floribunda	Weeping Lilly Pilly	15mx8m	45lt	16

Symbol	Name	Common Name	Size	Pot Size	NO.
SHRUBS					
ASM	Acmena smithii Minor	Dwarf Lilly Pilly	5mx3m	75mm	33
BE	Banksia ericifolia	Coastal Banksia	5mx5m	"	50
CC	Callistemon citrinus Endeavour	Endeavour Bottlebrush	3mx3m	"	62
CG	Ceratapetalum gummiferum	NSW Christmas Bush	5mx3m	"	20
MH	Melaleuca hypericifolia	Red Flowering Paperbark	4mx2m	"	9
MT	Metrosideros Thomasii	NZ Christmas Bush	8mx4m	"	45
SA	Syzyglum australae	Brush Box		"	51

Symbol	Name	Common Name	Size	Pot Size	NO.
GRASSES + GROUNDCOVERS					
DR	Dianella Breeze	Flax Lily	0.5mx0.5m	75mm	179
LL	Lomandra longifolia	Matt Rush	1mx1m	"	127
LT	Lomandra Tanika	Dwarf Mat Rush	.75mx.75m	"	147
MS	Microlena stipoides	Weeping Grass	1mx1m	"	169
PE	Poa Eskdale	BlueTussock Grass	.75mx.75m	"	199



ELEVATION Not to Scale

FABRICATION SLAB 20mx20m

DESIGN NOTES

Landscape contractor must show extreme care in protecting services and works by other contractors. This will include all paths and structures.

MOUNDING OF GARDEN BEDS

Landscape contractor is to allow to install extra soil to provide mounding to the planting bed to a maximum hieght of 400mm. This will provide a medium for good growth.

CULTIVATION OF EXISTING GROUND

Existing ground is to be ripped and cultivated to a depth of 200mm minimum with gypsum to be incorporated. See specification for rates.

GARDEN EDGING

Timber edging shall be installed along the boundary fence to deter grass invading the planting beds.

FERMENTER MODIFICATIONS
PROPOSED EQUIPMENT SHOWN IN RED.
SHOALHAVEN STARCHES PTY. LTD.

ISS	DATE	ZONE	CHANGE AMENDMENTS	BY	CKD
A		ALL			

MANILDRA GROUP
100% AUSTRALIAN

DRAWN
TRACED
CHECKED
APPROVED
DRG PRACTICE AS1100

TITLE: MANILDRA GROUP.NOWRA
FERMENTER AREA.LAYOUT.
PROPOSED FERMENTERS #16 & #17 & ASSOCIATED EQUIPMENT.

PPLA
Peter Phillips Landscape Architecture

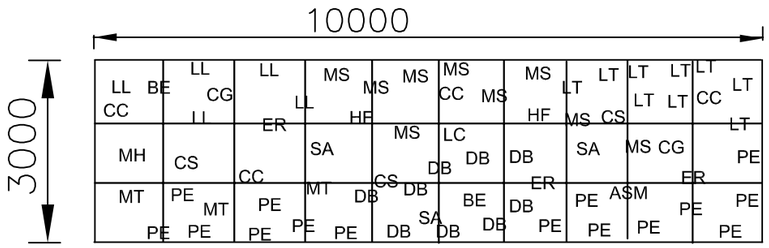
4 BINDON CLOSE BOMADERRY 2541 FAX : 0244221310 MOB : 0410040507

PROJECT : PROPOSED MODIFICATIONS TO FERMENTERS MANILDRA FACTORY
For : MANILDRA GROUP NOWRA

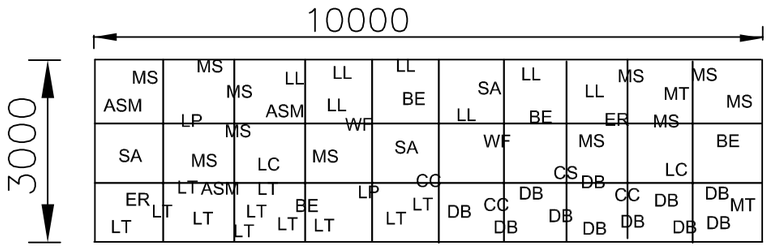
LANDSCAPE PLAN

SCALE : 1:500 A3 | DWG. LO1 | Rev : A

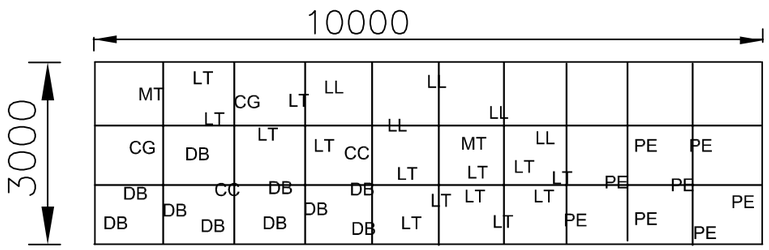
DATE : April 2012 | DRAWN : Peter Phillips



TYPE A MATRIX
1:25



TYPE B MATRIX
1:25



TYPE C MATRIX

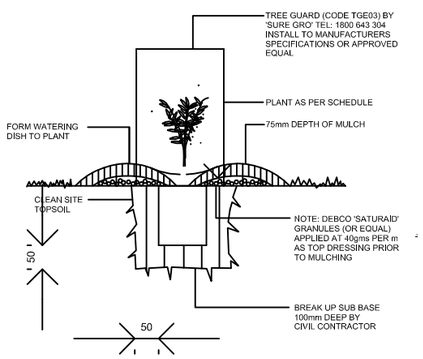
TREES	Name	Common Name
CC	Callistemon salignus	Callistemon Pink Tips
ER	Elaeocarpus reticulatus	Blueberry Ash
HF	Hymenosporum flavum	Native frangipani
LP	Leptospermum petersonii	Lemon Scented Tea Tree
LC	Lophostemon confertus	Brushbox
WF	Waterhousia floribunda	Weeping Lilly Pilly

SHRUBS

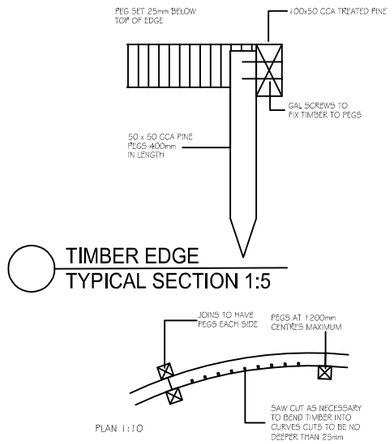
ASM	Acmena smithii Minor	Dwarf Lilly Pilly
BE	Banksia ericifolia	Coastal Banksia
CC	Callistemon citrinus Endeavour	Endeavour Bottlebrush
CG	Ceratapetalum gummiferum	NSW Christmas Bush
MH	Melaleuca hypericifolia	Red Flowering Paperbark
MT	Metrosideros Thomasii	NZ Christmas Bush
SA	Syzygium australae	Brush Box

GRASSES + GROUNDCOVERS

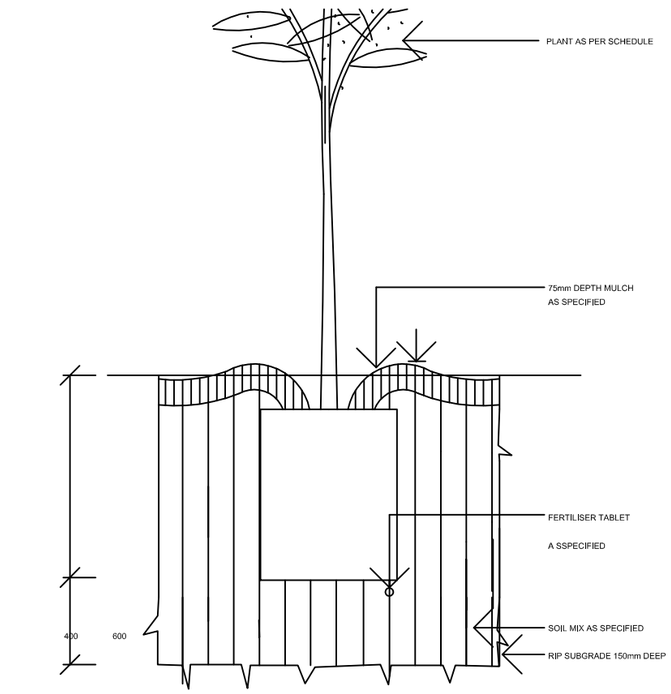
DR	Dianella Breeze	Flax Lily
LL	Lomandra longifolia	Matt Rush
LT	Lomandra Tanika	Dwarf Mat Rush
MS	Microlena stipoides	Weeping Grass
PE	Poa Eskdale	BlueTussock Grass



REVEG TUBE PLANTING
TYPICAL SECTION 1:10



TIMBER EDGE
TYPICAL SECTION 1:5



TREE PLANTING
TYPICAL SECTION NTS

SPECIFICATION NOTES

SERVICES
Before landscape work is commenced. The Landscape Contractor is to establish the position of all service lines and ensure tree planting is carried out at least 3 metres away from these services. Service lids, vents and hydrants shall be left exposed and not covered by any landscape finishes (turfing, paving, garden beds etc.) Finish adjoining surfaces flush with pit lids.

PLANTING MIXTURE
Shall be Native Plant Mix as supplied by Soilco Ph 02 44229944

MULCH
APPLICATION: Place mulch to the required depth, (refer to drawings clear of plant stems, and rake to an even surface finishing 25mm below adjoining levels. Ensure mulch is watered in and tamped down during installation.
MULCH TYPE:

- Brush chippings and leaf litter: approved vegetative material (which may include leaf matter and tree loppings from Eucalyptus, Tristania, Pinus or other suitable species, but not privet, camphor laurel, coral tree, poplar, willow, or noxious weeds), processed through a chipper to pieces not larger than 75x50x15mm.

PLANT MATERIAL
All plants supplied are to conform with those species listed in the Plant Schedule on the drawings. Generally plants shall be vigorous, well established, hardened off, of good form consistent with species or variety, not soft or forced, free from disease or insect pests with large healthy root systems and no evidence of having been restricted or damaged. Trees shall have a leading shoot. Immediately reject dried out, damaged or unhealthy plant material before planting. All stock is to be container grown for a minimum of six (6) months prior to delivery to site.

FERTILISER
MASS PLANTING AREAS: Fertiliser shall be 'Nutricote' or approved equivalent in granule form intended for slow release of plant nutrients over a period of approximately nine months. Thoroughly mix fertiliser with planting mixture at the recommended rate, prior to installing plants.
TURF: Shall be Shirleys No. 17 or approved equal thoroughly mixed into the topsoil prior to placing turf.
TREES IN GRASS AND SUPER ADVANCED TREES: Pellets shall be in the form intended to uniformly release plant food elements for a period of approximately nine months equal to Shirleys Kokei pellets, analysis 6.3:1.8:2.9. Kokei pellets shall be placed at the time of planting to the base of the plant, 50mm minimum from the root ball at a rate of two pellets per 300mm of top growth to a maximum of 8 pellets per tree.

STAKING AND TYING
Stakes shall be straight hardwood, free from knots and twists, pointed at one end and sized according to size of plants to be staked.

a.	5-15 litre size plant	1x(1200x25x25mm)
b.	35-75 litre size plant	2x(1500x38x38mm)

Ties shall be 50mm wide hessian webbing or approved equivalent nailed or stapled to stake. Drive stakes a minimum one third of their length, avoiding damage to the root system, on the windward side of the plant.

MAINTENANCE NOTES

Landscape contractor must carry out maintenance for a minimum period of 26 weeks from the date of practical completion of revegetation works to ensure the full establishment of plant material. Maintenance is to include but not be limited to watering, weeding, rubbish removal, staking and tying, fertilising, pest and disease control, replacement of dead plant material and turf, renovation, pruning, cultivation and reinstatement of mulch.

DURATION AND ATTENDANCE
Landscape contractor is to attend the site weekly for the duration of the stated maintenance or plant establishment period and maintain the site to the satisfaction of Council.

WATERING
Water grasses, trees, shrubs, groundcovers to ensure their establishment and continued healthy,
Water at 2 day intervals in the first 3 weeks and then weekly for the next 12 weeks

RUBBISH
Remove rubbish from site at each weekly maintenance visit to ensure neat presentation of site at all times.

PLANT MATERIAL
Replace all dead, damaged or missing plant material at contractor's cost. Replacement plants are to be identical to those originally installed unless otherwise approved by Landscape Architect. Replacements shall be made within 2 weeks of the plant failing or being removed.

STAKING
Replace or adjust stakes and ties as required or directed by Landscape Architect. Remove stakes and ties at end of maintenance period or as directed by Landscape Architect.

PRUNING
Remove dead, diseased or damaged plant material to improve the health, vigour and foliage density of the plant material. Remove and dispose of prunings away from site according to relevant authorities regulations.

MULCH
Reinstate mulch to maintain 75mm depth. Ensure mulch does not contact plant stems.

PEST AND DISEASES
Report detection of pests and diseases to Landscape Architect as soon as they are noticed. Spray according to manufacturer's recommendations to control infestations of pests and diseases.

PPLA
Peter Phillips Landscape Architecture
4 BINDON CLOSE BOMADERRY 2541 FAX : 0244221310 MOB : 0410040507

PROJECT : PROPOSED MODIFICATIONS TO FERMENTERS
MANILDRA FACTORY
MANILDRA GROUP NOWRA
For :

DETAILS, MATRIX,SPECIFICATION & MAINTENANCE NOTES

SCALE : 1:200	DWG. LO2	Rev : A
DATE : aPRIL 2012	DRAWN : Peter Phillips	

ANNEXURE 6

WMAWater's Response

to Shoalhaven City Council's submission concerning Flooding Issues

ANNEXURE 6

Manildra Group
36 Bolong Road
BOMADERRY NSW 2541

11107/L120405
MP06_0228

5 April 2012

Attention: **Mr Brian Hanley**
Manager Shoalhaven Starches

Dear Brian,

Re: Shoalhaven Starches Expansion Project MP06_0228
Additional Information Regarding Flooding

Further to our report of 20th December 2011 (attached as Appendix 5 of your submission on the above) Shoalhaven City Council (in their submission to the Department of Planning) *request that the applicant include an assessment that the additional structures do not impede the ability of staff to evacuate the site in flood emergencies and/or impact adversely on existing residential structures on the flood plain.*

This letter provides a response to these two issues.

1. Additional structures do not impede the ability of staff to evacuate the site in flood emergencies

Shoalhaven Starches has a Flood Evacuation Plan for the site (dated April 2008) which deals with the evacuation of staff during a flood. The additional structures that are included as part of the proposed works will not require additional staff and thus will not increase the number of workers that are required to be evacuated during a flood. Furthermore as best we can determine the proposed structures will not be located in a manner that is likely to inhibit the ability of staff to evacuate the site during a flood in a safe manner in accordance with the Flood Evacuation Plan.

2. Impact adversely on existing residential structures on the flood plain

Our report of 20th December 2011 states:

The results indicate that the incremental increase in flood level (for the full range of design flood events) as a result of the proposed works shown on Figure 1 is less than 0.01m. A change in flood level of +/- 0.01m in flood level is within the order of accuracy of the flood modelling process and cannot accurately be defined. This very small increase in flood level is to be expected given the magnitude of the floodplain of the lower Shoalhaven River and the relatively minor extent of the proposed works.

Webb, McKeown & Associates Pty Ltd (trading as WMAwater) **ABN 50 366 075 980**
DIRECTORS ASSOCIATES Level 2, 160 Clarence St, SYDNEY NSW 2000
M K Babister BE(Hons), MEngSc GradDipMgt, FIEAust E J Askew BE(Hons), MIEAust Phone: 02 9299 2855 Fax: 02 9262 6208
G L Hurrell BSC, BE(Hons), MIEAust S D Gray BE, MEng Email: enquiry@wmawater.com.au
R W Dewar BSc(Hons), MEngSc, MAIG, MIEAust R Hardwick Jones BE(Hons), MEngSc, MIEAust Website: wmawater.com.au

Our conclusion is therefore that the proposed works will not adversely affect existing residential structures on the floodplain.

We trust that the above adequately responds to the issues raised by Shoalhaven City Council, however if you have any queries regarding the above please do not hesitate to contact the undersigned.

Yours faithfully,

WMAwater

R W Dewar

Director

ANNEXURE 7

ANNEXURE 7

Response from Day Design Pty Ltd
to
Construction Noise Issue
raised by DoPI

DAY DESIGN PTY LTD

A.B.N. 73 107 291 494

CONSULTING ACOUSTICAL ENGINEERS

50 Junction Street
Nowra NSW 2541
Phone: (02) 4421 2933 Fax: (02) 9584 2619
Email: southcoast@daydesign.com.au
www.daydesign.com.au

Shoalhaven Starches Pty Ltd
C/- Cowman Stoddart Pty Ltd
PO Box 738
Nowra NSW 2541

Refer: 4701-l1

Attention: Mr Stephen Richardson
Telephone: 02 4423 6198

11 April 2012

Dear Sir,

Shoalhaven Starches Modification to Ethanol Plant,

Construction Noise

Day Design Pty Ltd submitted an Environmental Noise Impact Assessment for the proposed modification to ethanol plant at Shoalhaven Starches in November 2011, report number 4701-r1 dated 29/11/11.

Following the submission of the report the NSW Department of Planning and Infrastructure has requested additional information in relation to the potential noise generated during the construction phase of the project. We are pleased to offer the following response:-

It is proposed to construct two fermentation tanks at the northern end of the site and install an additional distillation column and evaporator within the ethanol distillery. The construction works involved will consist predominantly of assembling and erecting prefabricated sections of the fermentation tanks and the distillation plant, producing very minimal noise emission.

However, there will piling works associated with the construction of concrete slabs for the two fermentation tanks using a piling rig. Piling works will occur sporadically throughout the day and last a maximum of two weeks.

The current EPA licence noise conditions relate to the operation of the Shoalhaven Starches site and are derived from previously measured background noise levels during night time hours. These limits are not applicable to noise emission from construction works. Noise emission from construction works in NSW is assessed against the EPA's *Interim Construction Noise Guideline 2009.*

The guideline sets a noise management level, under a quantitative assessment, of background noise level plus 10 dB. Day Design Pty Ltd has conducted numerous noise surveys in the Nowra and Bomaderry areas and has found typical day time background noise levels to range between

40 and 45 dBA depending on the location. This results in a typical noise management level of 50 to 55 dBA for construction noise emission in the area.

To consider the likelihood of noise emission from the proposed construction works as part of the ethanol upgrade we have assumed a sound power level (L_w) for a piling rig of 118 dBA.

The predicted level of noise emission from piling activity at each of the sensitive receiver locations is calculated to be between 42 and 48 dBA depending on the receptor location. Full details of receiver locations can be seen in Section 3 of report 4701-r1, dated 29 November 2009.

This level is below a conservative day time construction noise management level and considerably less than the highly noise affected level of 75 dBA. We recommend normal construction hours as defined by the EPA are maintained during piling works, as follows:-

- 7.00 am to 6.00 pm Monday to Friday;
- 8.00 am to 1.00 pm Saturday; and
- No work on Sunday or Public Holiday

Given the location, nature and duration of construction works we are of the opinion that noise emission from construction will have a negligible impact on residential receptors for this proposal.

Please do not hesitate to contact the undersigned should you require any further information or clarification.

Yours sincerely,

Matthew Harwood MAAS
Senior Acoustical Consultant
for and on behalf of Day Design Pty Ltd

SGS Quality Certified

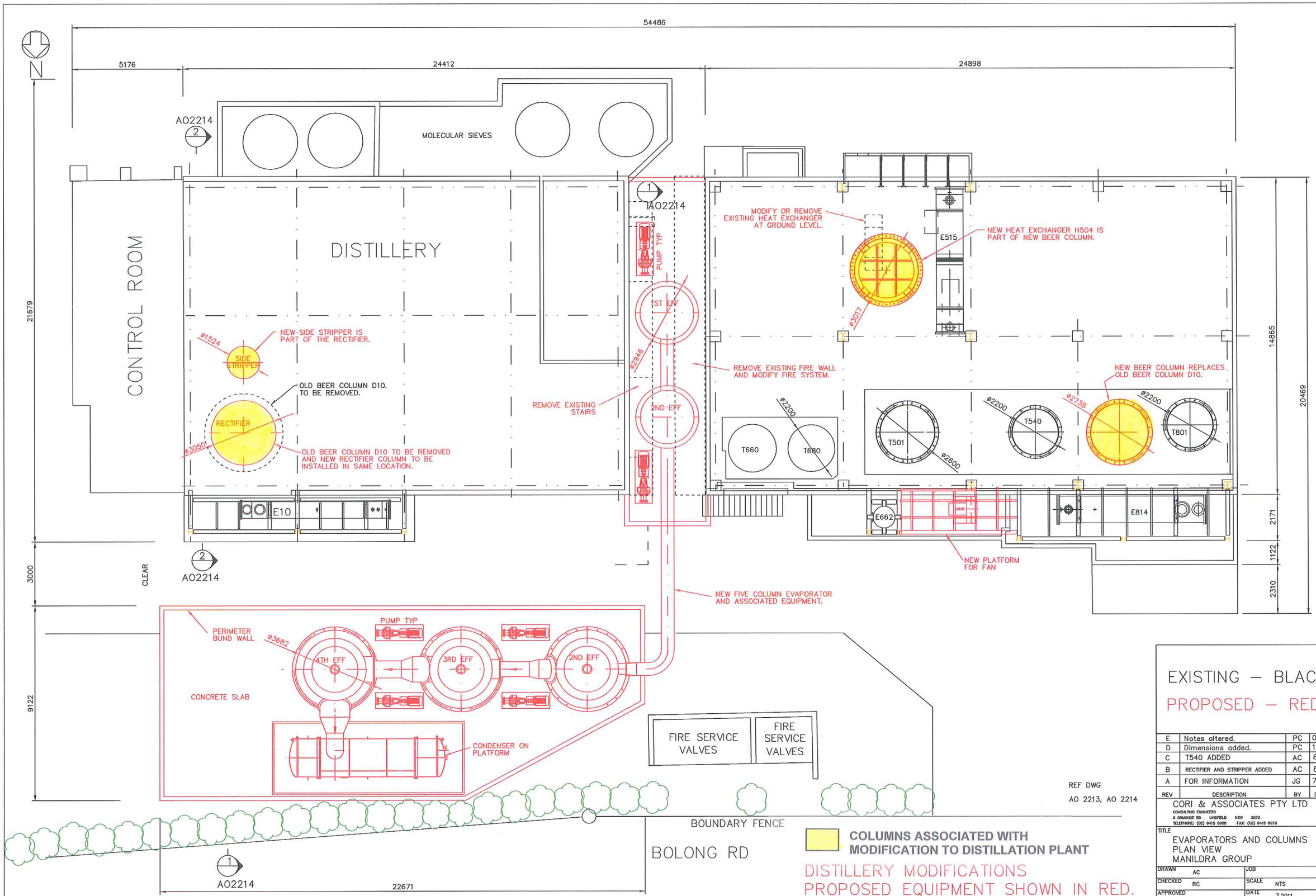
The undersigned hereby certifies that this Report has been checked and approved in accordance with our Quality Management System.

Date: 12/4/12

ANNEXURE 8

ANNEXURE 8

Plans supporting
Modification Application Submission and which highlight columns associated with modifications to Distillation Plant



PLAN VIEW

REF DWG
AO 2213, AO 2214

COLUMNS ASSOCIATED WITH MODIFICATION TO DISTILLATION PLANT

DISTILLERY MODIFICATIONS
PROPOSED EQUIPMENT SHOWN IN RED.
SHOALHAVEN STARCHES PTY. LTD.

EXISTING – BLACK.
PROPOSED – RED

REV	DESCRIPTION	BY	DATE
E	Notes altered.	PC	01.12
D	Dimensions added.	PC	12.11
C	T540 ADDED	AC	8.11
B	RECTIFIER AND STRIPPER ADDED	AC	8.11
A	FOR INFORMATION	JG	7.11

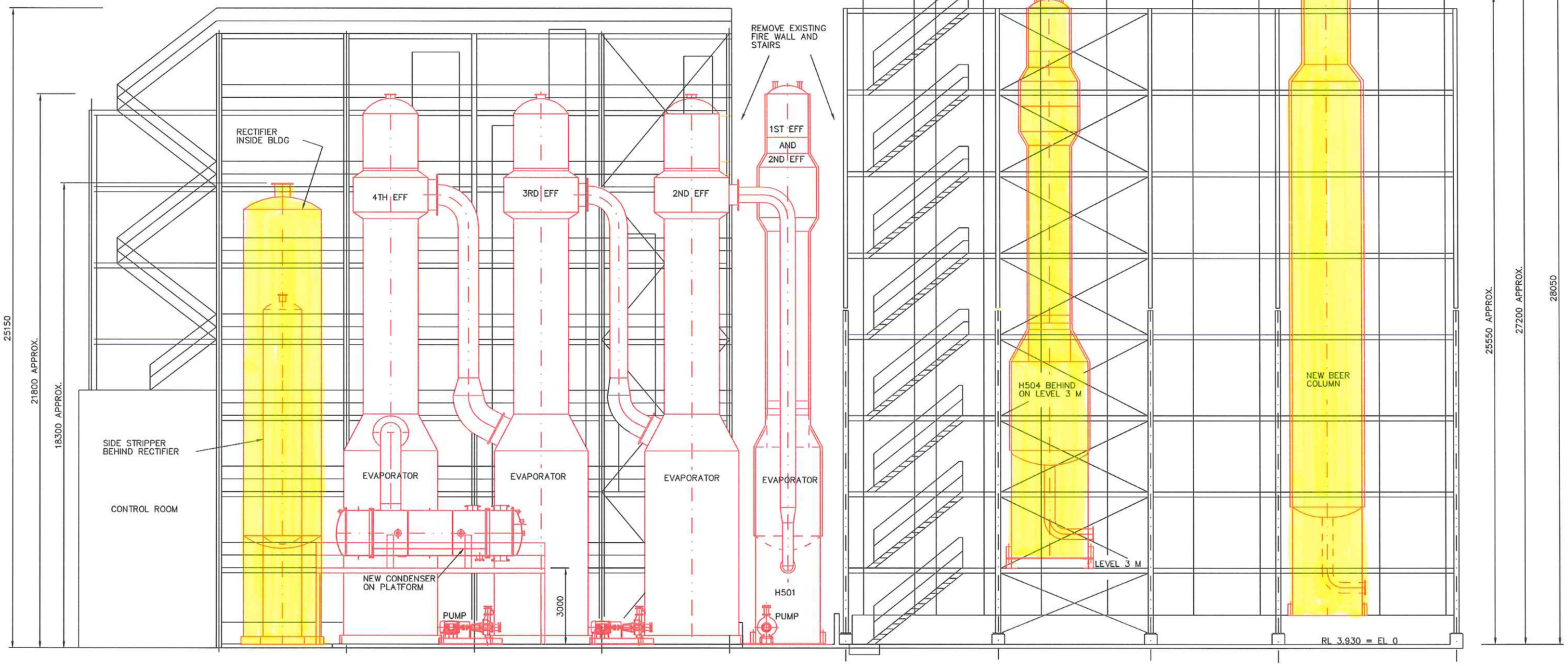
CORI & ASSOCIATES PTY LTD
CONSULTING ENGINEERS
9 ORMONDE RD LINDFIELD NSW 2070
TELEPHONE: (02) 9415 6000 FAX: (02) 9415 6070

TITLE
EVAPORATORS AND COLUMNS
PLAN VIEW
MANILDRA GROUP

DRAWN	AC	JOB	
CHECKED	RC	SCALE	NTS
APPROVED		DATE	7.2011
CLIENT	MANILDRA		MR–6027

DRAWING No AO 2212 REV D

EXISTING – BLACK.
PROPOSED – RED



ELEVATION LOOKING SOUTH

0 1 2 3 4 5 6 7 8 9 10 METRE

COLUMNS ASSOCIATED WITH MODIFICATION TO DISTILLATION PLANT

DISTILLERY MODIFICATIONS
PROPOSED EQUIPMENT SHOWN IN RED.
SHOALHAVEN STARCHES PTY. LTD.

REF DWG

AO 2212, AO 2214

REV	DESCRIPTION	BY	DATE
D	Dimensions added.	PC	12.11
C	T540 ADDED	AC	8.11
B	RECTIFIER AND STRIPPER ADDED	AC	8.11
A	FOR INFORMATION	AC	7.11

CORI & ASSOCIATES PTY LTD
CONSULTING ENGINEERS
9 ORMONDE RD LINDFIELD NSW 2070
TELEPHONE: (02) 9415 6060 FAX: (02) 9415 6070

TITLE
EVAPORATORS AND COLUMNS
ELEVATION LOOKING SOUTH
MANILDRA GROUP

DRAWN AC	JOB
CHECKED RC	SCALE NTS
APPROVED	DATE 7.2011
CLIENT MANILDRA	MR–6028
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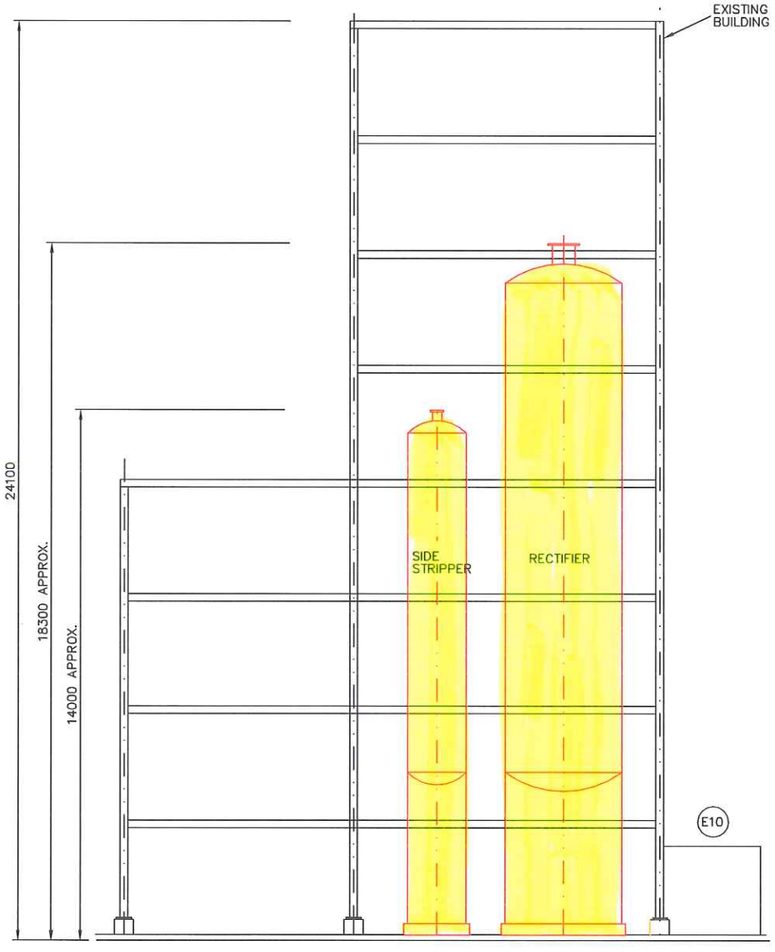
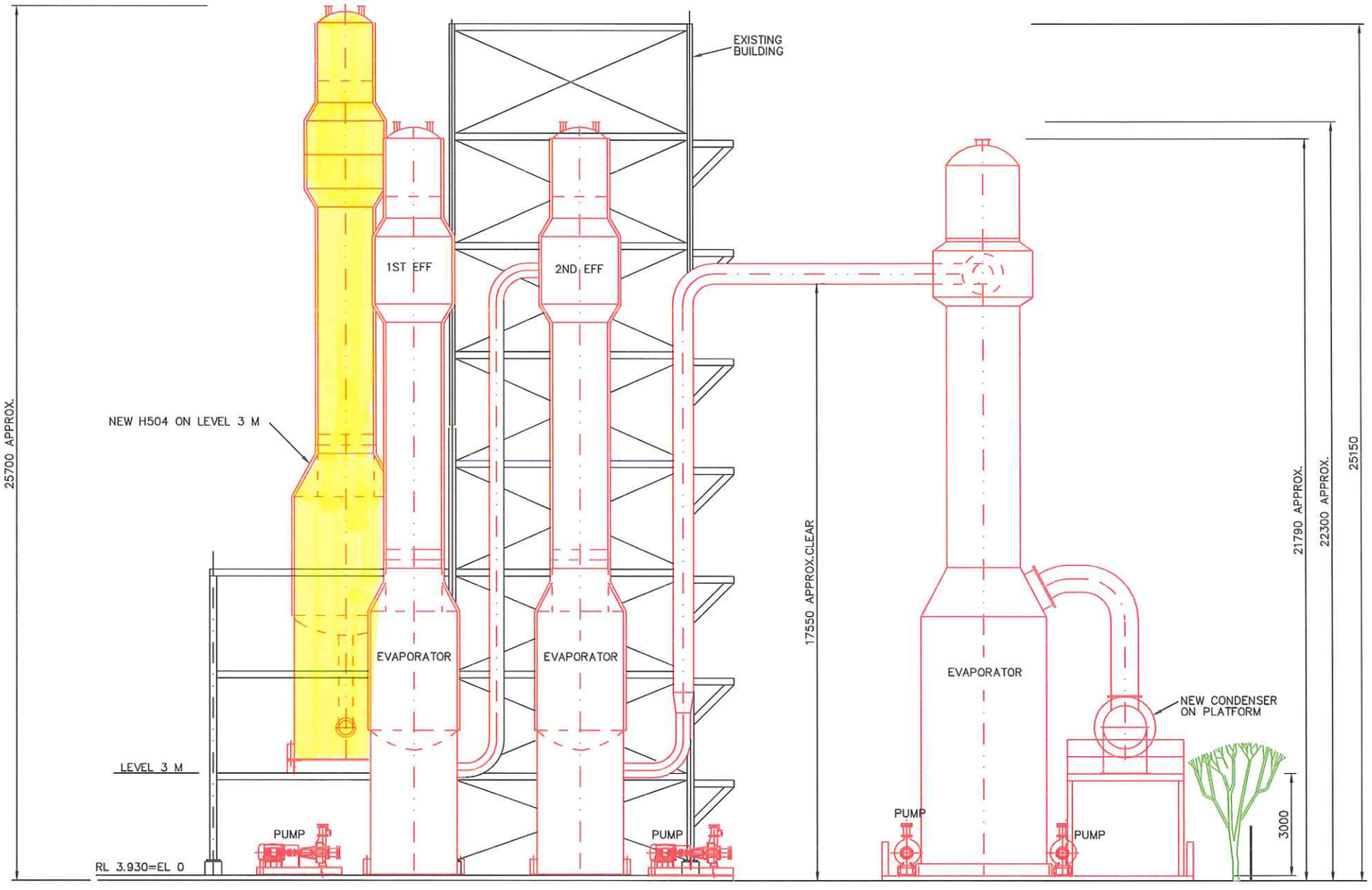
PROPOSED – RED



2 SECTION AO 2212



1 SECTION AO 2212

0 1 2 3 4 5 6 7 8 9 10 METRE

COLUMNS ASSOCIATED WITH MODIFICATION TO DISTILLATION PLANT

DISTILLERY MODIFICATIONS
PROPOSED EQUIPMENT SHOWN IN RED.
SHOALHAVEN STARCHES PTY. LTD.

REF DWG
AO 2212, AO 2213

REV	DESCRIPTION	BY	DATE
C	Dimensions added.	PC	12.11
B	RECTIFIER AND STRIPPER ADDED	AC	8.11
A	FOR INFORMATION	JG	7.11

CORI & ASSOCIATES PTY LTD
CONSULTING ENGINEERS
9 ORMONDE RD LINDFIELD NSW 2070
TELEPHONE (02) 9415 6800 FAX (02) 9415 6970

TITLE
EVAPORATORS AND COLUMNS
SECTION 1
MANILDRA GROUP

DRAWN JG	JOB
CHECKED RC	SCALE NTS
APPROVED	DATE 7.2011
CLIENT MANILDRA	MR-6026
DRAWING No AO 2214	REV C

EXISTING – BLACK.
PROPOSED – RED

Shoalhaven River

12000
13125
14470

3250
6000
7155
ϕ17500 FOOTING
6100
20000
ϕ17500 FOOTING
PROPOSED FABRICATION SLAB 20m x 20m
100
ϕ17500 FOOTING
20000

PROPOSED COMPRESSOR ROOM
RECEIVER
AIR CON.
AIR CON.
PROPOSED EXPANSION. ELECT. SWITCH/SUB STATION 7
ELECT. SWITCH/SUB STATION 7
EXISTING AMENITIES
EXISTING AMENITIES
EXISTING AMENITIES
JIM'S OFFICE
EXISTING DRAINAGE SUMP 19Mx7Mx3.5M DEEP VOLUME = 465.5 m³ CAPACITY = 465,500 Litres
FM
EXISTING PUMP HOUSE
FERMENTERS 10,11 &12 COMPLETED
15
14
12
11
10
16
13
17
ϕ17.5
EMERGENCY LADDER
CIP TANK SLAB
FM
ROADWAY
SERVICE ROADWAY
5M BUFFER
3M BUFFER
3M BUFFER
3M BUFFER
PROPOSED LANDSCAPING
BOLONG RD.

FERMENTER MODIFICATIONS
PROPOSED EQUIPMENT SHOWN IN RED.
SHOALHAVEN STARCHES PTY. LTD.

ISS	DATE	ZONE	CHANGE AMENDMENTS	BY	CKD
C	21–12–11	All	Dimensions added.	P.C.	G.M.
B	29–11–11	D3	Construction slab added.	P.C.	G.M.
A	17–11–11	C4	Fermenter centres were 23.5m	P.C.	G.M.
1	16–11–11	ALL	For gantry tender.	P.C.	G.M.

MANILDRA GROUP
100% AUSTRALIAN

DRAWN P.C.
TRACED
CHECKED
APPROVED
DRG PRACTICE AS1100
FINISH N/A
MATERIAL: N/A

TITLE: MANILDRA GROUP.NOWRA
FERMENTER AREA.LAYOUT.
PROPOSED FERMENTERS #16 & #17 & ASSOCIATED EQUIPMENT.

SIZE A3 SCALE: 1:500 SHT. 1of1
ISSUE 5198
DRG No. MN–FER–002C

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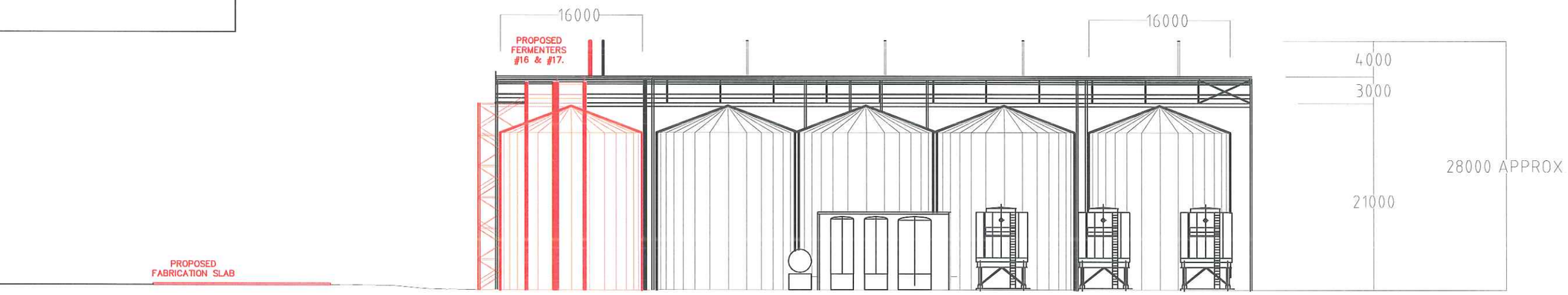
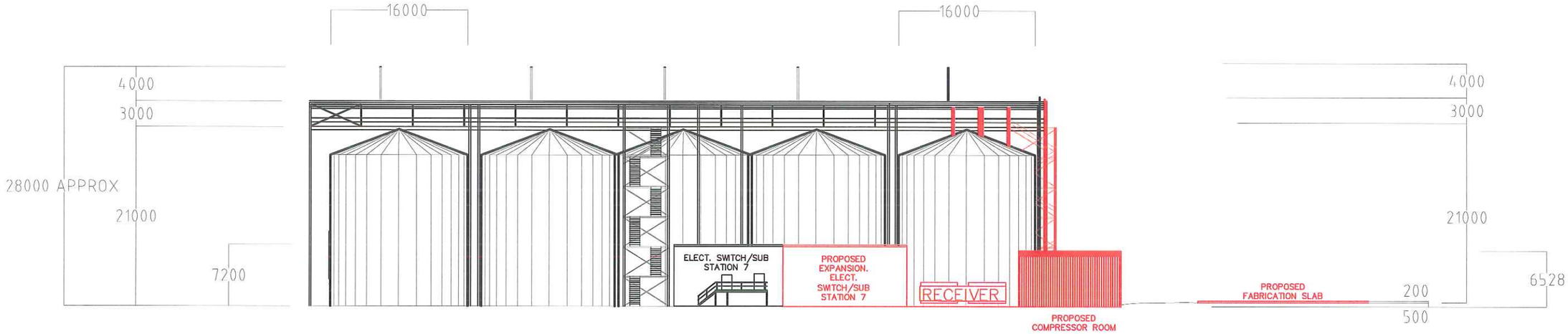
PROPOSED – RED



NORTHERN ELEVATION.



SOUTHERN ELEVATION..

FERMENTER MODIFICATIONS
PROPOSED EQUIPMENT SHOWN IN RED.
SHOALHAVEN STARCHES PTY. LTD.

ISS	DATE	ZONE	CHANGE AMENDMENTS	BY	CKD
1	21–12–11	ALL	For approval.	P.C.	G.M.

MANILDRA GROUP
100% AUSTRALIAN

DRAWN P.C.
TRACED
CHECKED
APPROVED
DRG PRACTICE AS1100
FINISH N/A
MATERIAL: N/A

TITLE: MANILDRA GROUP.NOWRA
FERMENTER AREA.ELEVATIONS.
PROPOSED FERMENTERS #16 & #17 & ASSOCIATED EQUIPMENT.

SIZE A3 | SCALE: 1:500 | SHT. 1of1
ISSUE 5198
DRG. Nº. MN–FER–003