ANNEXURE 6

Environmental Noise Impact Assessment

prepared by

Day Design Pty Ltd

ANNEXURE 6

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Environmental Noise Impact Assessment

Proposed Alterations to Existing Flour Mill
Shoalhaven Starches, Bolong Road, Bomaderry, NSW

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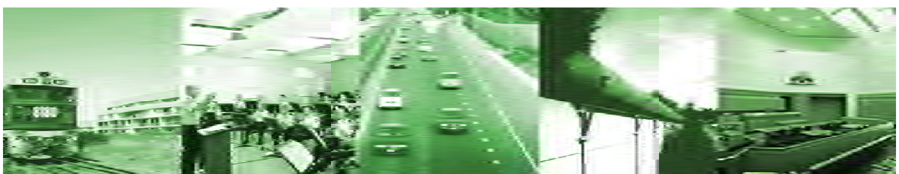

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1.0 EXECUTIVE SUMMARY

Shoalhaven Starches Pty Ltd is part of the Manildra Group of companies and their existing Bomaderry complex produces a range of products including starch, gluten, glucose, ethanol and stock feed.

Their existing facility is located on the southern side of Bolong Road, Bomaderry, NSW, on the northern side of the Shoalhaven River. The surrounding area is a mix of commercial, industrial and residential premises. The nearest residences are located in the township of Bomaderry to the north-west and across the Shoalhaven River in Nowra to the south and Terara to the south-east.

Shoalhaven Starches propose to undertake modifications to their existing Flour Mill to increase the amount of flour that will be able to be produced on site. The Flour Mill is located on the southern side of the site, toward the western end as shown in Figure 1 and the attached Appendix A.

The modifications will include the installation of three (3) new roller mills and a sifter within the mill building and additional conveyors, bucket elevators and four (4) extraction fans that will exhaust to the roof, as shown in the attached Appendices B and C.

Shoalhaven Starches operates under Environment Protection Licence Number 883 which sets noise limits for the overall operation of the complex. Noise goals have been designed for the proposal so as to ensure existing noise levels are not increased by the introduction of the new plant and equipment. The noise goals for any new plant are a minimum 10 dB below the EPL noise limits and range between 28 dBA and 32 dBA depending upon the residential receptor location.

These noise goals are also in accordance with Shoalhaven Starches Noise Management Plan originally prepared 31 October 2009 and revised 7 September 2010 under the Project Approval conditions for the Shoalhaven Starches Expansion Project.

Noise modelling has been undertaken using a combination of measured noise levels from existing indicative plant and equipment as well as manufacturer's noise data.

The only noise sources associated with the proposed modification that will require noise controls are the four fans, which will each be fitted with silencers. Minimum insertion loss data for the silencers is provided in Section 7 of this report.

Providing the recommendations are satisfactorily implemented, the level of noise emitted by the Flour Mill, following the modifications, will comply with the Shoalhaven Starches Environment Protection Licence noise limits and Shoalhaven City Council's general noise requirements.

The construction works associated with the modification will be minor and include the operation of a mobile crane and manual installation of the components within the existing building.

Calculations show that the level of noise emission from the construction phase will be within noise management levels set in accordance with the NSW EPA's *Interim Construction Noise Guideline* at all receptor locations.

2.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Shoalhaven Starches Pty Ltd to assess the potential environmental noise impact of proposed modifications to the existing Flour Mill at their existing complex on Bolong Road, Bomaderry, NSW.

This commission involves the following:

Scope of Work:

- Inspect the site and environs
- Prepare a site plan identifying the proposal and nearby noise sensitive locations
- Establish acceptable noise level criteria and design goals
- Quantify noise emission from the proposal
- Calculate the level of noise emission, taking into account building envelope transmission, distance loss, screen walls, etc
- Consider noise emission from the construction phase of the development
- Provide recommendations for noise control if necessary
- Prepare an Environmental Noise Impact Assessment Report.

3.0 SITE AND DEVELOPMENT DESCRIPTION

3.1 Site Description

The Shoalhaven Starches complex is located on the southern side of Bolong Road across the Shoalhaven River from Nowra.

The area surrounding Shoalhaven Starches is a mix of commercial, industrial and residential premises with vacant land, owned by the Manildra Group, to the north.

The nearest residential locations to the proposal are as follows:-

- Location 1 – Nobblers Lane, Terara approximately 1400 metres to the south east
- Location 2 – Riverview Road, Nowra approximately 975 metres to the south west;
- Location 3 – Meroo Street, Bomaderry approximately 620 metres to the north west;
- Location 4 – Coomea Street, Bomaderry approximately 750 metres to the north west;

Locations are listed in keeping with the order shown in the Environment Protection Licence (see Section 4.1 of this report).

The Shoalhaven Starches site, surrounding area and receptor locations are shown in Figure 1.

3.2 Development Description

It is proposed to undertake modifications to the existing Flour Mill in order to increase the amount of flour that can be produced on site. The modifications will include the installation of three new roller mills, a sifter, chain conveyors, bucket elevators and four (4) extraction and collection fans that will each exhaust to the roof of the building. It is proposed to fit each of the fans with acoustic silencers and details of the silencer performance requirements are provided in Section 7 of this report.

Figure 1. Location Plan – Shoalhaven Starches, Bomaderry *(source: Google Maps Imagery © 2015).*

4.0 ACOUSTICAL CRITERIA

This section presents the noise guidelines applicable to this proposal and establishes the project specific noise criteria.

4.1 NSW EPA Requirements

In their email response to a request for information relating to requirements to be addressed in preparing a modification application, correspondence dated 8 September 2015, the NSW EPA states:-

"Noise Impacts:

It is recommended that a noise impact assessment in accordance with the Industrial Noise Policy (EPA 2000) be prepared that assesses the potential operational noise impacts of the proposal.

The noise impact assessment should identify whether the proposal will comply with the existing noise limits in the EPL and if not, provide details of all reasonable and feasible mitigation measures that will be implement to ensure compliance.

Potential construction noise impacts should be assessed and determined in accordance with the provisions of the Interim Construction Noise Guideline (DECC 2009)."

4.2 Protection Licence 883

Shoalhaven Starches operates under Environment Protection Licence 883 issued by the NSW Environment Protection Authority.

Section L5 'Noise Limits' of the licence states:-

"L5.1 the $L_{A10\ (15min)}$ sound pressure level contribution generated from the premises must not exceed the following levels when measured at or near the boundary of any residential premises:

a) 38 dBA at locations in Terara on the south side of the Shoalhaven River;

b) 38 dBA at locations in Nowra on the south side of the Shoalhaven River;

c) 42 dBA at locations in Meroo Street, Bomaderry;

d) 40 dBA at other locations in Bomaderry."

These noise limits apply to the overall operation of the Shoalhaven Starches complex.

4.3 Shoalhaven Starches Noise Management Plan

Previous approval for the Shoalhaven Starches Expansion Project, required the preparation of a Noise Management Plan for addressing and managing noise emission from the expansion project.

The Shoalhaven Starches Noise Management Plan originally prepared 31 October 2009 and revised 7 September 2010 addresses, among other things, acoustic criteria relating to the

Shoalhaven Starches complex and any new developments. Section 3 of the plan lists noise limits from the Environmental Protection Licence as shown in Section 4.1 above and states:-

"Compliance testing conducted on a regular basis on behalf of the Mill [Shoalhaven Starches complex] *has found noise emission from the premises satisfies the EPA criteria as a result of works on the Shoalhaven Starches site. In order to ensure that there is no increase in noise emission from the subject premises, with respect to the noise criteria nominated by the EPA in License Condition 6.3* [now 5.1]*, the design goal for such additional plant should be at least 10 dB below the criteria nominated by the EPA."*

4.4 EPA Construction Noise Guideline

The NSW EPA published the *Interim Construction Noise Guideline* in July 2009. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

The Guideline presents two ways of assessing construction noise impacts; the quantitative method and the qualitative method.

The quantitative method is generally suited to longer term construction projects and involves predicting noise levels from the construction phase and comparing them with noise management levels given in the guideline.

The qualitative method for assessing construction noise is a simplified way to identify the cause of potential noise impacts and may be used for short-term works, such as repair and maintenance projects of short duration.

In this instance the entire construction phase may take several months although significant noise producing aspects, such as piling, if required, will last a total of approximately two weeks. Consideration is given to the potential for noise impact from construction activities on residential receptors in Section 6 of this report.

Table 2 in Section 4 of the Guideline sets out noise management levels at affected residences and how they are to be applied during normal construction hours. The noise management level is derived from the rating background level (RBL) plus 10 dB in accordance with the Guideline. This level is considered to be the 'noise affected level' which represents the point above which there may be some community reaction to noise.

Day Design has carried out numerous noise surveys in Nowra, Bomaderry and Terara and has found daytime background noise levels range between 33 and 40 dBA depending on the location, as shown in Table 1 below.

Table 1 Rating Background Levels

Noise Measurement Location	Time Period	Rating Background Level
135 Terara Road, Terara March 2012	Day (7 am to 6 pm)	**33 dBA**
55 Terara Road, Nowra February 2015	Day (7 am to 6 pm)	**36 dBA**
Cambewarra Rd, Bomaderry July 2010	Day (7 am to 6 pm)	**40 dBA**
Shoalhaven Village Caravan Park, Nowra March 2012	Day (7 am to 6 pm)	**40 dBA**

For the purpose of determining the potential for community reaction to noise emission from construction activities, previously measured background noise levels in the vicinity of each receptor location have been used to determine the noise management levels as shown in Table 2 below.

Table 2 L_{eq} Noise Management Levels from Construction Activities

Receptor Location	Noise Management Level	How to Apply
Location 1 (Terara) Location 2 (Nowra) Locations 3 & 4 (Bomaderry)	**43 dBA** (33 + 10) **50 dBA** (40 + 10) **50 dBA** (40 + 10)	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq\ (15\ min)}$ noise level is greater than the noise affected level, the proponent should apply all feasible and reasonable* work practices to meet the noise affected level. ▪ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. ▪ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

* Section 6, "work practices" of The *Interim Construction Noise Guideline*, states:- *"there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts.*

This approach gives construction site managers and construction workers the greatest flexibility to manage noise".

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

The 'highly noise affected' level of 75 dBA represents the point above which there may be strong community reaction to noise. This level is provided in the Guideline and is not based on the RBL.

4.5 Project Specific Noise Criteria

When all the above factors are considered, we find that the most stringent noise criteria for the proposed modification are as follows:-

Operational Phase (Environment Protection Licence noise limits less 10 dB) -

- *28 dBA ($L_{10,\ 15\ minute}$) at locations in Terara on the south side of the Shoalhaven River;*
- *28 dBA ($L_{10,\ 15\ minute}$) at locations in Nowra on the south side of the Shoalhaven River;*
- *32 dBA ($L_{10,\ 15\ minute}$) at locations in Meroo Street, Bomaderry;*
- *30 dBA ($L_{10,\ 15\ minute}$) at other locations in Bomaderry.*

Construction Phase Noise Management Levels

- *43 dBA ($L_{eq,\ 15\ minute}$) at locations in Terara;*
- *40 dBA ($L_{eq,\ 15\ minute}$) at locations in Bomaderry and Nowra.*

The residential criteria apply at the most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the most-affected point within 30 metres of the residence. For upper floors, the noise is assessed outside the nearest window.

5.0 FLOUR MILL MODIFICATION OPERATIONAL NOISE EMISSION

5.1 Plant and Equipment Noise Levels

The main sources of noise associated with the modification to the Flour Mill will be the four (4) extraction fans, roller mills, sifter, conveyors and bucket elevators.

Day Design Pty Ltd has conducted several noise surveys at Shoalhaven Starches' complex including noise measurements of plant and equipment within and around the existing Flour Mill. In addition, the manufacturers of the proposed fans have supplied sound levels for each model.

Table 3 below provides a schedule of the octave band and overall 'A' frequency weighted sound power levels, in decibels re: 1 pW, of noise sources associated with the modification.

Table 3 L_{10} Sound Power Levels – Grain Silos

Mechanical Plant	dBA	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
Fan – 160-040030-00	**119**	120	120	118	118	113	108	102	96
Fan – 160-016030-00	**117**	112	115	116	117	111	104	96	85
Fan – 031-018030-00	**100**	102	102	100	99	94	89	84	78
Fan – 035-007530-00	**98**	100	99	97	97	92	87	81	75
Roller Mill	**104**	97	99	104	105	95	89	85	82
Sifter	**93**	94	94	94	93	87	83	80	78
Bucket Elevator	**94**	91	89	90	89	87	88	85	86
Chain Conveyor	**86**	86	85	83	80	79	81	78	69

5.2 Predicted Noise Levels

Knowing the sound power level of a noise source (see Table 3), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for building envelope transmission, distance losses, etc.

Table 4 below shows the predicted noise level at each of the receptor locations from the plant and equipment associated with the proposed modification.

Table 4 Predicted Noise Levels at Receptor Locations – Flour Mill Modification

Description	Predicted Noise Level $L_{10,\ 15\ minute}$ (dBA) at Receptor Location			
	Location 1	**Location 2**	**Location 3**	**Location 4**
Fan – 160-040030-00	18	21	25	23
Fan – 160-016030-00	18	21	25	23
Fan – 031-018030-00	13	16	20	18
Fan – 035-007530-00	10	14	17	16
Roller Mill & Sifter	18	20	22	21
Elevators & Conveyors	17	20	24	22
Combined	**24**	**27**	**31**	**29**
Acceptable Noise Limit ($L_{10,\ 15\ minute}$)	28	28	32	30
Complies	**Yes**	**Yes**	**Yes**	**Yes**

The above calculations and predictions consider distance loss to each receptor and the following:-

- Transmission loss through the Flour Mill building for the roller mills and sifter;
- Flour mill building of masonry (concrete) construction;
- Bucket elevator main motors located within the building; and
- Silencers fitted to each of the fans as outlined in Section 7 of this report.

6.0 CONSTRUCTION NOISE EMISSION

The construction process will involve manoeuvring the items of plant and equipment in to place within the building using an internal hoist already in place. Externally mounted equipment will be lifted to the rooftop via an electric tower crane also already in place on site. Prior to the placement of internal plant penetrations will be cut into the floors where required using a concrete saw.

Noise emission from the construction phase will be inaudible at each receptor, particularly as the majority of work will occur within the masonry mill building.

However, for the purpose of predicting noise emission from construction activities, for completeness, we have modelled use of the concrete saw with a sound power level of 116 dBA, to each receptor location.

Table 5 below shows the predicted level of noise emission from construction activities at each of the receptor locations.

Table 5 Predicted Noise Levels at Receptor Locations – Construction Phase

Description	Predicted Noise Level $L_{eq,\,15\,minute}$ (dBA) at Receptor Location			
	Location 1	Location 2	Location 3	Location 4
Construction Activity	20	23	26	25
Acceptable Noise Limit ($L_{eq,\,15\,minute}$)	43	50	50	50
Complies	**Yes**	**Yes**	**Yes**	**Yes**

7.0 NOISE CONTROL RECOMMENDATIONS

7.1 Fan Silencers

It is proposed to fit each of the fans with silencers. We recommend fitting silencers to the discharge side of each fan. Each of the silencers should achieve the minimum insertion losses shown in Table 6 below:-

Table 6 Silencer Insertion Losses

	Minimum Insertion Loss (dB) at Octave Band Centre Frequencies (Hz)							
	63	125	250	500	1k	2k	4k	8k
Fan – 160-040030-00 Silencer - NAP Silentflo H45/240	11	19	33	45	43	29	20	17
Fan – 160-016030-00 Silencer - NAP Silentflo H45/180	8	15	25	35	34	23	17	14
Fan – 031-018030-00 Silencer - NAP Silentflo H45/90	3	9	13	20	20	14	14	9
Fan – 035-007530-00 Silencer - NAP Silentflo H45/90	3	9	13	20	20	14	14	9

8.0 NOISE IMPACT STATEMENT

An assessment of the potential noise impact from proposed modifications to the existing Flour Mill at Shoalhaven Starches on Bolong Road, Bomaderry, NSW has been undertaken.

Calculations show that the level of noise emission from the operation of the plant and equipment associated with the modification will be within the noise design goals derived from Environment Protection Licence 883 noise limits at each receptor location. This is providing noise control recommendations made in Section 7 of this report are implemented.

Noise emission from the construction phase of the proposal will be well below noise management levels set in accordance with the NSW EPA's *Interim Construction Noise Guideline* at all receptor locations.

Matthew Harwood, MAAS
Senior Acoustical Consultant

for and on behalf of Day Design Pty Ltd

AAAC MEMBERSHIP

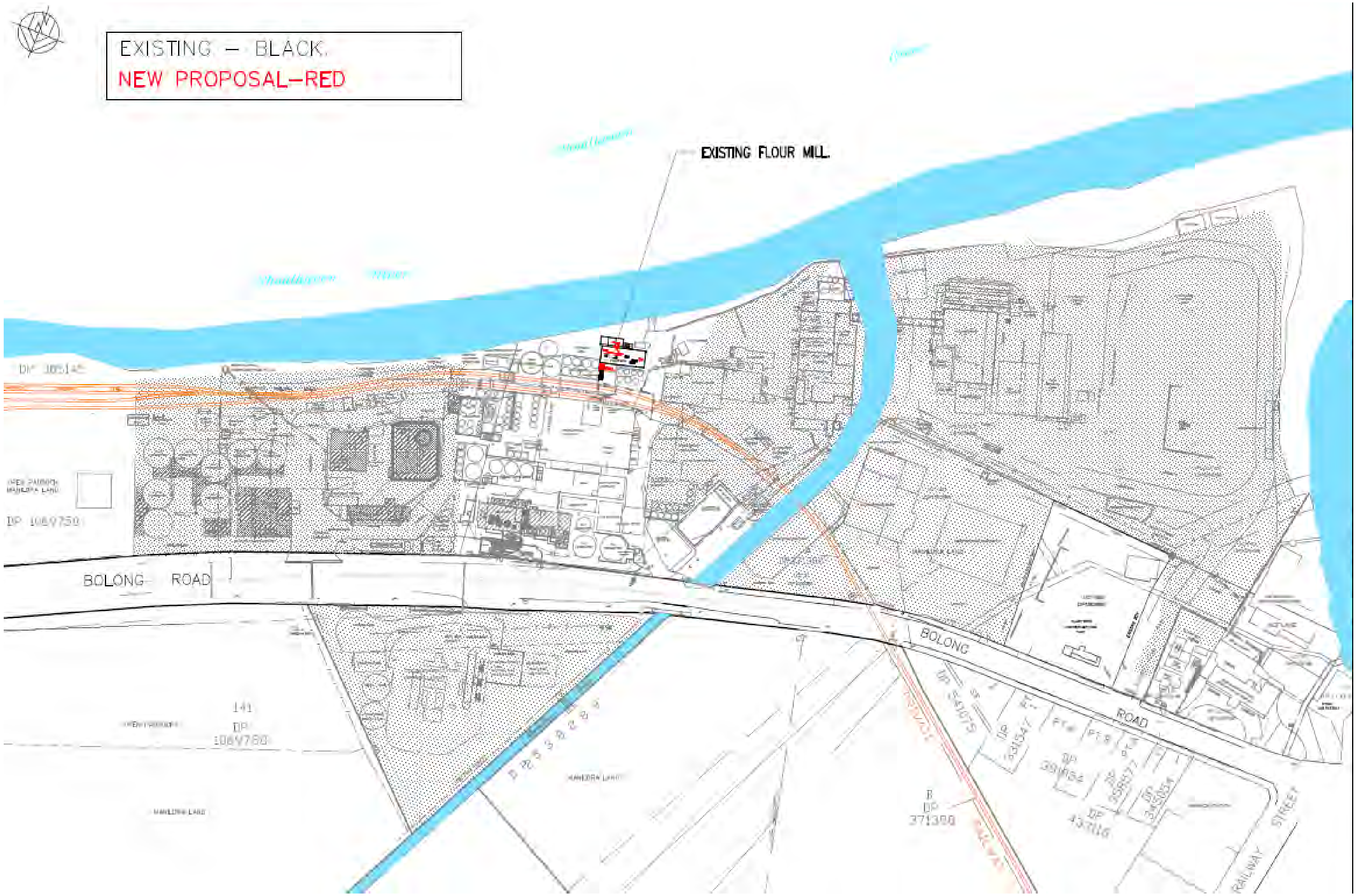
Day Design Pty Ltd is a member company of the Association of Australian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

Attachments:

Appendix A – Site Layout
Appendix B – Existing Mill with Proposed Modification Plant shown in Plan
Appendix C – Existing Mill with Proposed Modification Plant shown in Elevation

Site Plan – Showing Flour Mill with Modifications (Source: Manildra Group Dwg MN257-005C, dated June 2015)

Appendix A



Shoalhaven Starches – Bolong Road, Bomaderry, NSW
Proposed Flour Mill Modifications – Plan Views (Source: Manildra Group Dwg MN257-003C & 004C, dated 3/11/2015)

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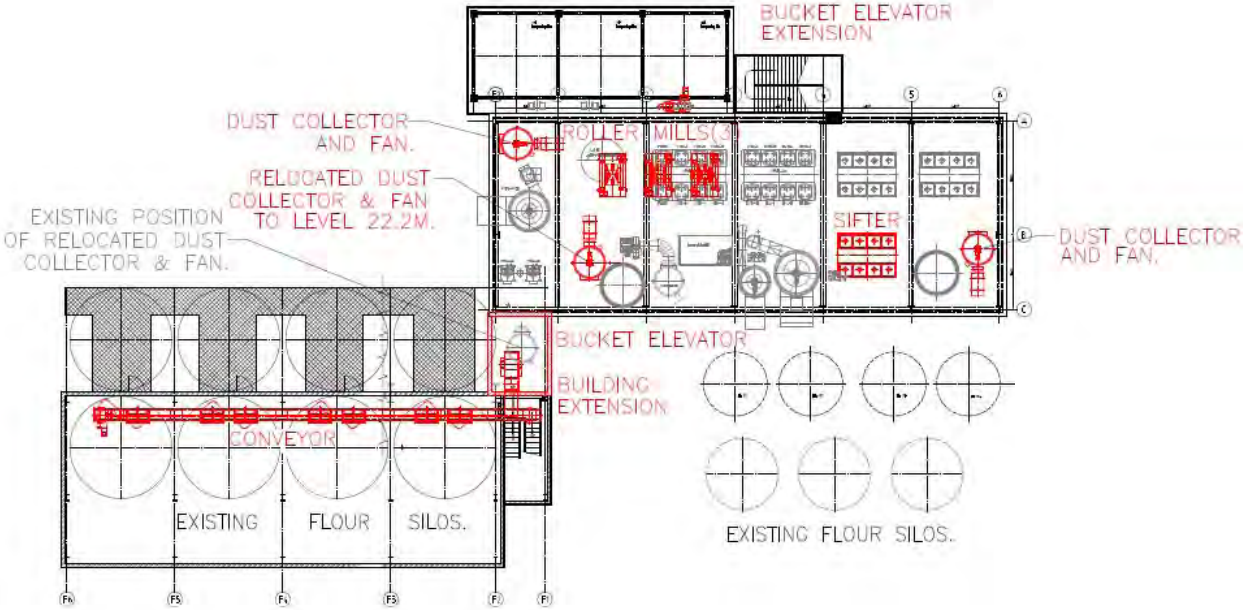
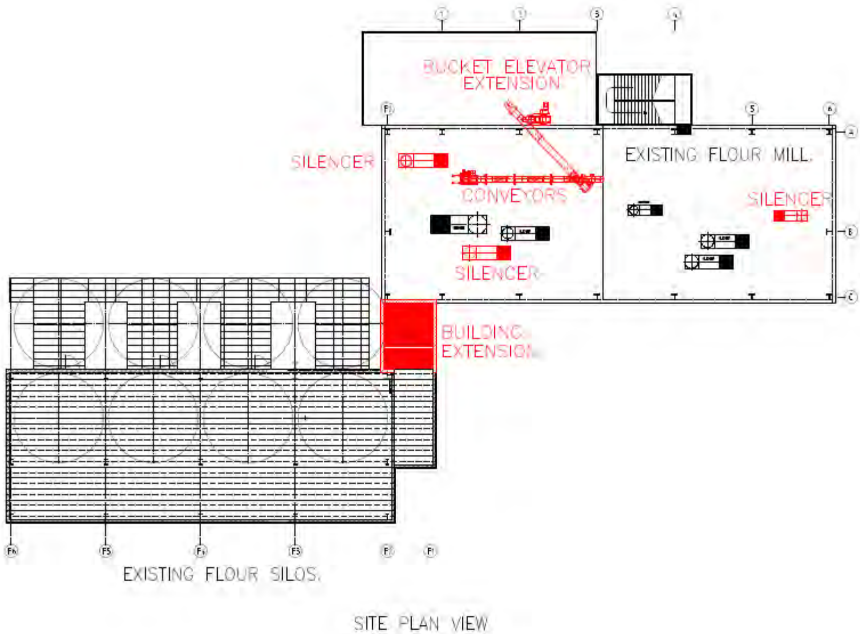
Appendix B





Shoalhaven Starches – Bolong Road, Bomaderry, NSW

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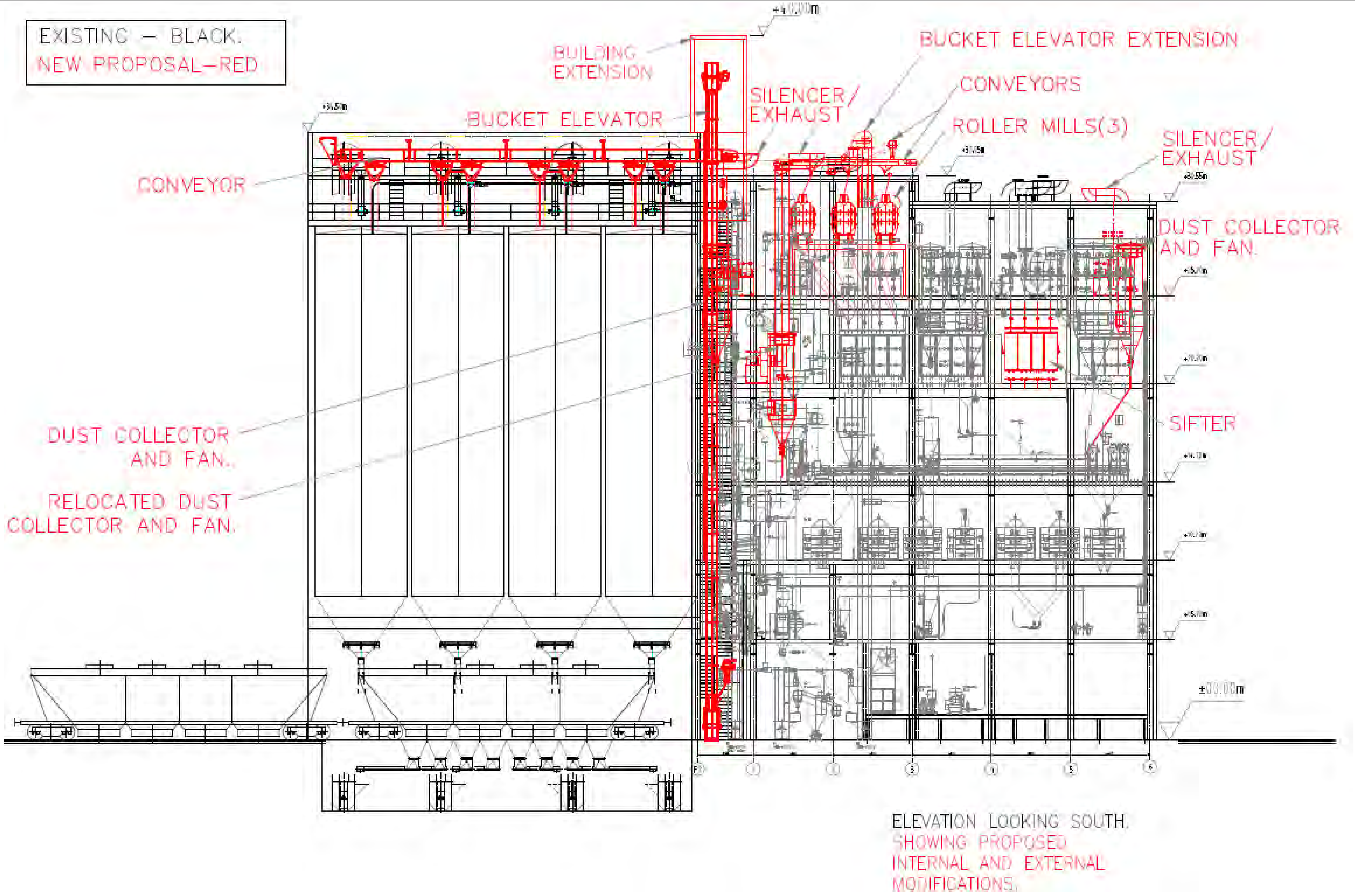
Proposed Flour Mill Modifications – Elevation (Source: Manildra Group Dwg MN257-002C, dated 3/11/2015)

Appendix C



ANNEXURE 7

Preliminary Hazard Analysis

prepared by

Pinnacle Risk Management

ANNEXURE 7

PRELIMINARY HAZARD ANALYSIS, ALTERATIONS TO EXISTING FLOUR MILL, SHOALHAVEN STARCHES, BOMADERRY, NSW

Prepared by: Dean Shewring

29 October 2015

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Preliminary Hazard Analysis, Shoalhaven Starches,

Alterations to the Existing Flour Mill

Disclaimer

Rev	Date	Description	Reviewed By
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EXECUTIVE SUMMARY

The Shoalhaven Starches factory located on Bolong Road, Bomaderry, produces a range of products for the food, beverage, confectionary, paper and motor transport industries including starch, gluten, glucose and ethanol.

Shoalhaven Starches intend to undertake modifications to the existing flour mill to increase the amount of flour that will able to be produced on the site. The expansion will include additional equipment within and on top of the existing flour mill building.

As part of the project requirements, a Preliminary Hazard Analysis (PHA) is required. This report details the results from the analysis.

The risks associated with the proposed modified flour mill at the Shoalhaven Starches Bomaderry site have been assessed and compared against the DoP risk criteria.

In summary:

- The potential hazardous events associated with the modified flour mill are dust explosions and smouldering fires. Given the nearest public land is approximately 120 m away and the river is 20 m away and the equipment is explosion protected well above ground level then no adverse off-site impacts are expected;
- All risk criteria in HIPAP 4 is expected to be satisfied for this development;
- Propagation to neighbouring equipment is not expected given that the potential dust explosions are either to be vented to atmosphere at a safe, elevated location or of limited consequential impact and the potential fires are of a smouldering nature; and
- Societal risk, environmental risk and transport risk are all considered to be broadly acceptable.

The recommendations included in the Hazardous Event Word Diagram (Table 1 in this report) will require addressing as part of the design for the modified flour mill. There are no other recommendations from the assessment performed in this PHA.

GLOSSARY

ATEX	Atmosphere Explosive (European Standard)
DDG	Dried Distillers Grain
DoP	NSW Department of Planning
HIPAP	Hazardous Industry Planning Advisory Paper
LAAB	(Equipment Trade Name)
LEL	Lower Explosive Limit
LFL	Lower Flammability Limit
NFPA	National Fire Protection Association
PHA	Preliminary Hazard Analysis
QRA	Quantitative Risk Assessment

REPORT

1 INTRODUCTION

1.1 BACKGROUND

From Ref 1, Shoalhaven Starches is a member of the Manildra Group of companies. The Manildra Group is a wholly Australian owned business and the largest processor of wheat in Australia. It manufactures a wide range of wheat based products for food and industrial markets both locally and internationally.

The Shoalhaven Starches factory located on Bolong Road, Bomaderry, produces a range of products for the food, beverage, confectionary, paper and motor transport industries including starch, gluten, glucose and ethanol.

Shoalhaven Starches intend to undertake modifications to the existing flour mill to increase the amount of flour that will able to be produced on the site. The expansion will include additional equipment within and on top of the existing flour mill building. The additional rooftop equipment will include:

- Additional silencers (there are currently silencers at this location);
- An additional screw conveyor and bin; and
- An additional bucket elevator.

The project will increase the total flour production capacity on site from 265,000 to 400,000 tonnes per year.

The expansion will require an additional 3,375 tonnes per week of wheat grain to feed the modified flour mill. This will be offset, however, by a reduction in the amount of flour exported (2,700 tonnes per week) to the Company's other flour mills. The net effect of this is an overall increase in rail freight of up to 675 tonnes per week to the site.

As part of the project requirements, a Preliminary Hazard Analysis (PHA) is required. Shoalhaven Starches requested that Pinnacle Risk Management prepare the PHA for the modifications to the existing flour mill. This PHA has been prepared in accordance with the guidelines published by the Department of Planning (DoP) Hazardous Industry Planning Advisory Paper (HIPAP) No 6 (Ref 2).

1.2 OBJECTIVES

The main aims of this PHA study are to:

- Identify the credible, potential hazardous events associated with the modifications to the existing flour mill;
- Evaluate the level of risk associated with the identified potential hazardous events to surrounding land users and compare the calculated risk levels with the risk criteria published by the DoP in HIPAP No 4 (Ref 3);

- Review the adequacy of the proposed safeguards to prevent and mitigate the potential hazardous events; and
- Where necessary, submit recommendations to Shoalhaven Starches to ensure that the modifications to the existing flour mill are operated and maintained at acceptable levels of safety and effective safety management systems are used.

1.3 SCOPE

This PHA assesses the credible, potential hazardous events and corresponding risks associated with the Shoalhaven Starches proposed modifications to the existing flour mill with the potential for off-site impacts only.

Rail transport risk is qualitatively reviewed given the rail system is an existing infrastructure for the site and the net increase in flour movements is relatively low.

1.4 METHODOLOGY

In accordance with the approach recommended by the DoP in HIPAP 6 (Ref 2) the underlying methodology of the PHA is risk-based, that is, the risk of a particular potentially hazardous event is assessed as the outcome of its consequences and likelihood.

The PHA has been conducted as follows:

- Initially, the modifications to the existing flour mill and their location were reviewed to identify credible, potential hazardous events, their causes and consequences. Proposed safeguards were also included in this review;
- As the potential hazardous events are located at a significant distance from other sensitive land users, the consequences of each potential hazardous event were estimated to determine if there is any possible unacceptable off-site impacts;
- Included in the analysis is the risk of propagation between the proposed equipment and the adjacent processes; and
- If adverse off-site impacts could occur, assess the risk levels to check if they are within the criteria in HIPAP 4 (Ref 3).

2 SITE DESCRIPTION

From Ref 1, the Shoalhaven Starches factory site is situated on various allotments of land on Bolong Road, Bomaderry, within the City of Shoalhaven (see Figure 1). The factory site, which is located on the south side of Bolong Road on the northern bank of the Shoalhaven River, has an area of approximately 12.5 hectares.

The town of Bomaderry is located approximately 0.5 km to the west of the factory site and the Nowra urban area is situated 2.0 km to the south west of the site. The “Riverview Road” area of the Nowra Township is situated approximately 600 metres immediately opposite the factory site across the Shoalhaven River.

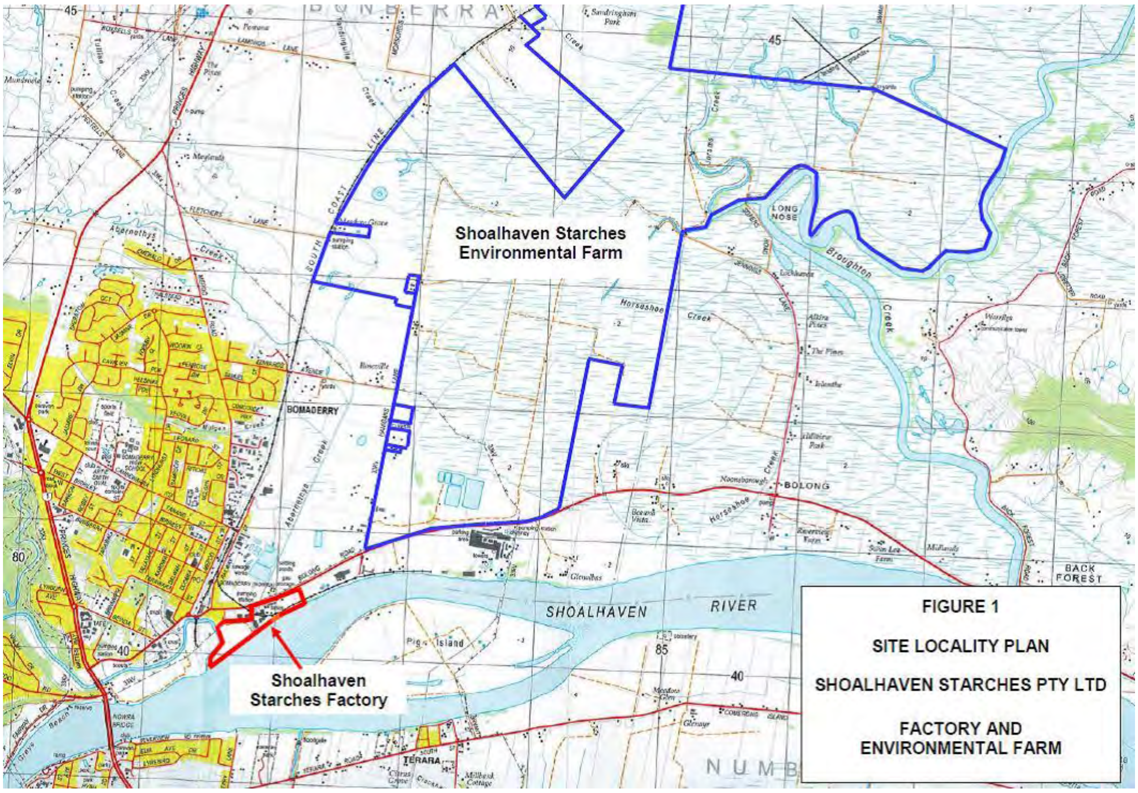
The village of Terara is situated approximately 1.5 kilometres to the south east of the site, across the Shoalhaven River. Pig Island is situated between the factory site and the village of Terara and is currently used for dairy cattle grazing.

There are a number of industrial land uses, which have developed on the strip of land between Bolong Road and the Shoalhaven River. Industrial activities include a metal fabrication factory, the Shoalhaven Starches site, Shoalhaven Dairy Co-op (formerly Australian Co-operative Foods Ltd – now owned by the Manildra Group) and the Shoalhaven Paper Mill (Australian Papers). The industrial area is serviced by a privately owned railway spur line that runs from just north of the Nowra-Bomaderry station via the starch plant and the former Dairy Co-op site to the Paper Mill.

The Company also has an Environmental Farm located over 1,000 hectares on the northern side of Bolong Road. This area is cleared grazing land and contains spray irrigation lines and wet weather storage ponds (total capacity 925 Mega litres). There are at present six wet weather storage ponds on the farm that form part of the waste water management system for the factory. A seventh pond approved in 2002 was converted into the biological section of the new wastewater treatment plant has now been commissioned.

The Environmental Farm covers a broad area of the northern floodplain of the Shoalhaven River, stretching from Bolong Road in the south towards Jaspers Brush in the north. Apart from its use as the Environmental Farm, this broad floodplain area is mainly used for grazing (cattle). The area comprises mainly large rural properties with isolated dwellings although there is a clustering of rural residential development along Jennings Lane (approximately 1 kilometre from the site), Back Forest Road (approximately 500 metres to 1.2 kilometres to the west) and Jaspers Brush Road (approximately 1.2 kilometres to the north).

Figure 1 - Site Locality Plan



Source: Ref 1.

Security of the site is achieved by a number of means. This includes site personnel and security patrols by an external security company (this includes weekends and night patrols). The site operates 7 days per week (24 hours per day). Also, the site is fully fenced and non-operating gates are locked. Security cameras are installed for staff to view visitors and site activities.

There are approximately 120 people on site during Monday to Fridays 8 am to 5 pm and 30 people on site at other times.

The main natural hazard for the site is flooding. No other significant external events are considered high risk for this site.

Layout drawings showing the proposed location of the modifications to the existing flour mill are shown in Figure 2 and Figure 3.

Figure 2 – Site Layout showing the Existing Flour Mill

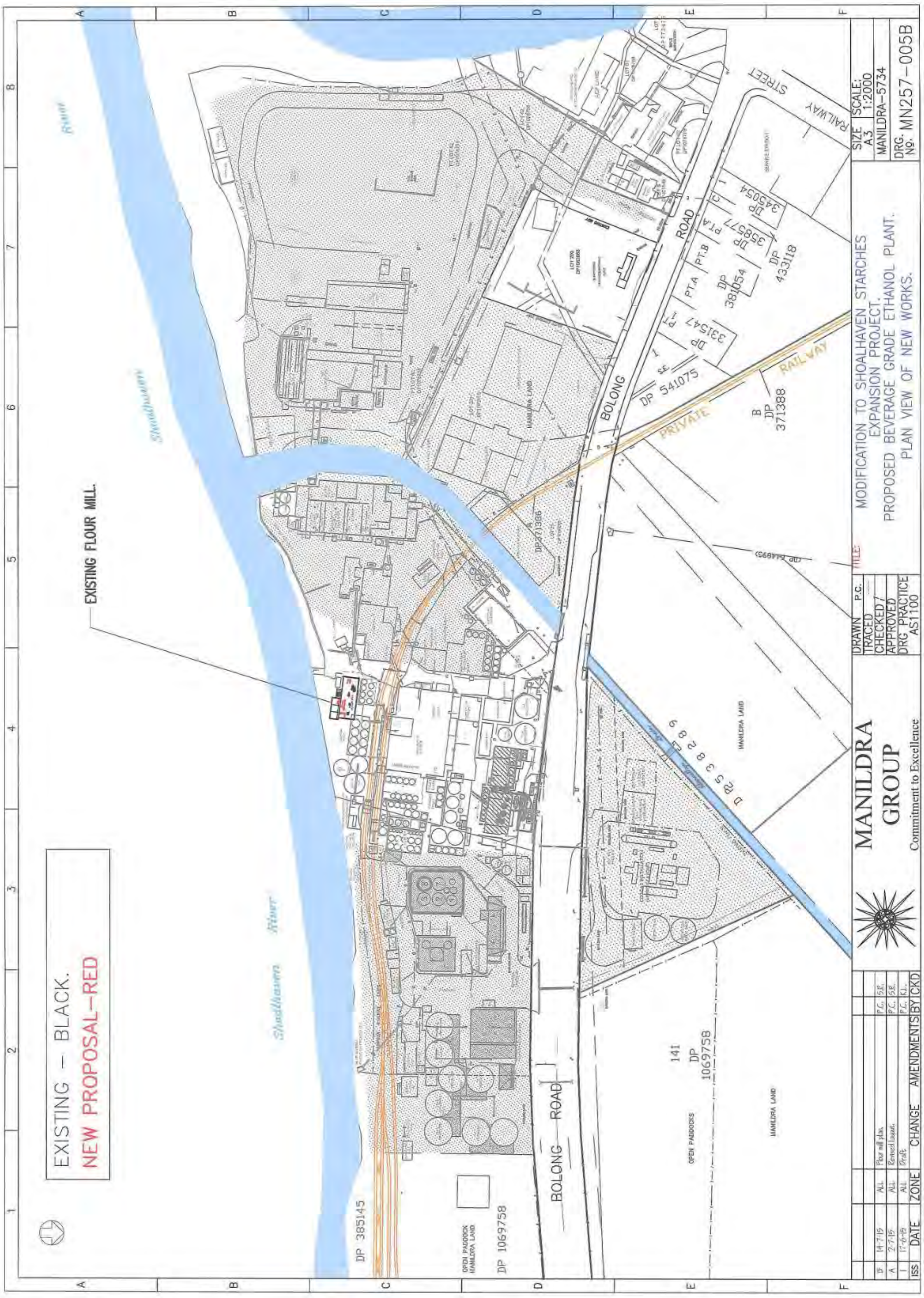
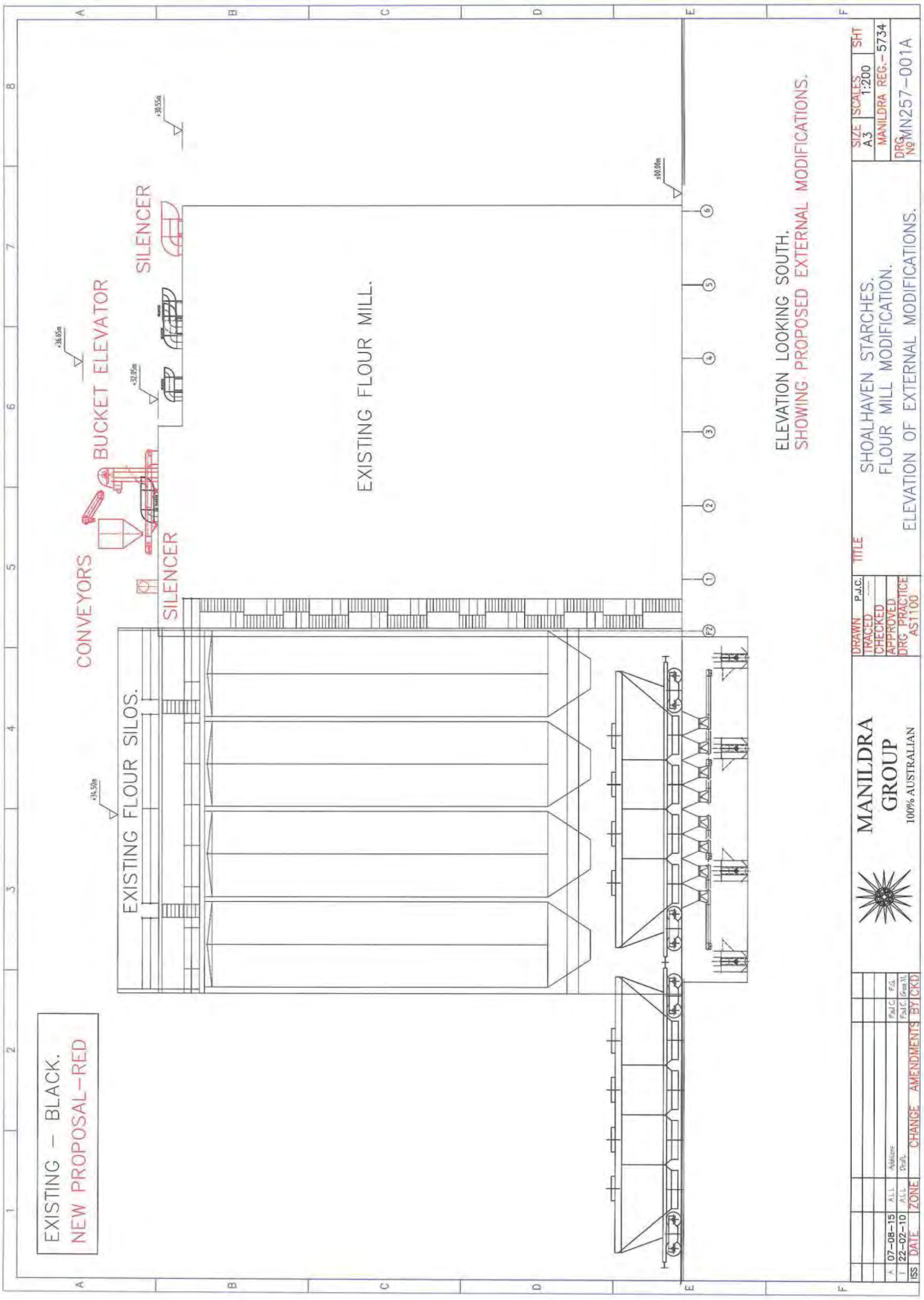


Figure 3 – New Equipment on the Rooftop of the Existing Flour Mill



3 PROCESS DESCRIPTION

3.1 EXISTING FLOUR MILL

Wheat is delivered to the site five times per week in rail hopper cars nominally of 60 tonne capacity. Each train delivers approximately 2,100 tonnes of wheat.

Wheat delivered to the site by train is discharged through a grid below the train hopper outlet using the grain intake system and is transported via drag chain conveyors and a bucket elevator system into two silos each of 1,600 tonne capacity.

Wheat is taken from the raw wheat silos, weighed and then passed through various cleaning operations as follows:

- Sieves for the removal of impurities larger or smaller than wheat;
- Gravity separators for the removal of heavy impurities such as stones;
- Magnetic separators for the removal of ferrous metal impurities; and
- Aspirators, using air currents, for the removal of lighter impurities.

The moisture content of wheat received at the site is typically in the range of 8% to 10% which is too dry for milling. Water is therefore be added to the wheat in a carefully controlled manner to increase the moisture content of the grain to around 15%. The damped wheat is then stored in a conditioning or tempering bin where it remains for a period of time (normally up to 24 hours) to allow the added moisture to be fully absorbed into the grain.

Conditioning of grain is necessary to:

- Assist in the separation of the component parts of the grain by toughening the bran to ensure a clean separation of the endosperm from the bran and germ; and
- Allow the reduction rollers to grind the endosperm into flour with the minimum power consumption and ensure accurate and easy sifting on the following sieving machines.

When the grain is at the optimum milling condition it is taken from the conditioning bins and passed through final scouring, weighing and separation stages before being passed to the mill.

Milling is carried out on roller mills which mills the grain into progressively finer fractions. Each milling process is followed by coarse sieving to separate large flakes of bran and chunks of endosperm which then passes to the next milling cycle. The finer starchy material is passed over a series of progressively finer sieves to remove any flour and to grade the remaining particles into various sizes for further grinding.

Flours from the various grinding operations is collected and blended together before passing through final treatment and weighing operations to bulk storage bins. Flour is taken from these bins for use in the site production processes.

The coarse particles left at the end of the reduction system, known as pollard, and the bran from the end of the break system is combined into a single by-product (DDG – Dried Distillers Grain) for sale as animal feed.

All air extracted from the mill is passed through bag houses prior to being discharged to the atmosphere.

Pneumatic conveying is used extensively to transport product throughout the mill. The air blower is mounted in an acoustic enclosure.

The mill is powered by electrical energy and uses compressed air only for instrument use.

The process is a dry process. There is no requirement for bunding and no process water is used other than the initial conditioning water which is 100% absorbed into the wheat and which comes from the water break tank.

A hazardous area zoning drawing has been developed for the mill. All equipment in any designated zoned areas is ATEX certified.

Given the above process description, no Dangerous Goods are involved with the flour mill.

3.2 PROPOSED MODIFICATIONS TO THE EXISTING FLOUR MILL

The new equipment will be housed entirely within the existing flour mill structure. No new storage silos will be required, either for grain or flour, as part of this project.

The processing of the additional volume of wheat will be accomplished by reducing the tempering time during the initial conditioning stage of the process. As discussed in Section 3.1, the wheat is dampened with water and then stored to allow water to penetrate into the wheat kernel. This makes the bran tough and elastic, and minimizes bran fines during milling. Reducing the tempering period will allow more efficient storage requirements for the wheat grain, in which case the existing silos will be sufficient for the additional grain processing requirements associated with this proposal.

New equipment (i.e. within the existing building and on the roof top) will include:

- Conveying and transfer systems for raw materials, intermediate products and flour. This includes chain conveyors, screw conveyors and bucket elevators;
- Additional roller mills (x3) and other equipment for grinding and processing flour. The additional equipment includes a third Combi Cleaner (for removing husk and stones), magnetic separators, weighers, dampeners (where water is added to the wheat) and impact detacher;
- A new 4 m^3 hopper for intermediate storage of residual material (wheat) within the front-end processing equipment when the plant trips;
- Sifters for separating various particle sizes; and
- Dust collectors (baghouse filters) for dust control.

As a result of the two additional dust collectors and fans, there will be two additional exhausts from the roof of the flour mill. These will be exhausted in the same way as the existing emission vents, i.e. though silencers and directed vertically upward.

The processing of additional flour on site will require an additional 14,200 litres of water per day (5,200 kilolitres per year) to temper the wheat grains. The additional water is absorbed by the grains and there will be no increase in waste waters generated by this process.

Process flow diagrams are included in Appendix 1.

4 HAZARD IDENTIFICATION

4.1 HAZARDOUS MATERIALS

Wheat:

Wheat, like barley, oats and rye, is a cereal grain. Wheat grains are generally oval shaped although different wheats have grains that range from almost spherical to long, narrow and flattened shapes. The grain is usually between 5 and 9 mm in length and weighs between 35 and 50 mg.

There are three main components to the grain:

Bran:

The outer coating or "shell" of the wheat kernel is made up of several layers. These layers protect the main part of the kernel.

Endosperm:

This is the main part of the wheat kernel and represents about 80% of the kernel weight. It is from this part that white flour is milled. The endosperm is rich in energy-yielding carbohydrate and important protein.

Germ or Embryo:

This part grows into a new plant if sown. The germ lies at one end of the grain and represents only 2% of the kernel. It is a rich source of B vitamins, oil, vitamin E and natural plant fat. It needs to be removed during milling because the fat is liable to become rancid during flour storage.

Dust from wheat can be formed by activities such as loading / unloading, filling a silo, milling and pneumatic conveying. It is a potentially explosive dust when critical parameters exist, e.g. particle size less than 500 micron and moisture content less than 30% (Ref 4).

Ignition sources include (Ref 5):

- Smouldering, self-heating or burning dust;
- Open flames, e.g. welding, hot work, cutting and matches;
- Hot surfaces, e.g. hot bearings, dryers, incandescent materials and heaters;
- Lightning;
- Heat from mechanical impact or friction; and
- Electrical discharges and arcs.

K_{st} is a measure of a dust's explosibility classification and is a measure of the maximum rate of pressure rise, i.e. the higher the K_{st} value, the greater the explosive energy. For grain dust, the K_{st} value is typically between 0 and 200 bar.m/s. These are deemed potentially weak explosions although it is noted that previous incidents involving grain dust explosions have led to fatalities (Refs 4 and 5).

Whilst grains are combustible when exposed to strong ignition sources, e.g. open flames, they typically burn as a smouldering type of fire and therefore do not pose significant radiant heat hazards. Smouldering grains, however, can be a precursor to dust explosions as the hot grains can provide the ignition energy to cause a dust cloud to deflagrate.

Grain dust is a respiratory sensitiser. This means it can trigger an allergic reaction in the respiratory system. Once this reaction has taken place, further exposure to the substance, even to very small amounts, may produce symptoms (Ref 6). The possible ill-health outcomes are:

- Rhinitis (runny or stuffy nose);
- Coughing and breathing difficulties;
- Asthma (attacks of coughing, wheezing and chest tightness);
- Chronic bronchitis (cough and phlegm production usually in winter months);
- Chronic obstructive pulmonary disease (a longer-term illness that makes breathing progressively difficult and includes chronic bronchitis and chronic asthma);
- Extrinsic allergic alveolitis, for example farmer's lung (fever, cough, increasing shortness of breath, muscle / joint pains and weight loss); and
- Organic dust toxic syndrome, for example grain fever (a sudden onset, short-lived, 'flu-like' illness with fever and often associated with cough and chest discomfort).

The above health effects are more likely for people with significant exposure to grain dust on-site but not off-site due to the controls to prevent fugitive emissions.

4.2 POTENTIAL HAZARDOUS INCIDENTS REVIEW

In accordance with the requirements of *Guidelines for Hazard Analysis*, (Ref 2), it is necessary to identify hazardous events associated with the facility's operations. As recommended in HIPAP 6, the PHA focuses on "atypical and abnormal events and conditions. It is not intended to apply to continuous or normal operating emissions to air or water".

In keeping with the principles of risk assessments, credible, hazardous events with the potential for off-site effects have been identified. That is, "slips, trips and falls" type events are not included nor are non-credible situations such as an aircraft crash occurring at the same time as an earthquake.

The identified credible, significant incidents (in particular, with the potential for off-site impacts) for the flour mill's existing and new equipment are summarised in the Hazard Identification Word Diagram following (Table 1). These potential events were determined during a hazardous event identification workshop involving project, design, technical, operations and maintenance personnel on the existing mill.

This diagram presents the causes and consequences of the events, together with major preventative and protective features that are to be included as part of the design.

Table 1 – Hazard Identification Word Diagram

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
1	Bucket elevators, chain conveyors and screw conveyors through the mill	Ignition of confined wheat dust	Foreign object, belt slip, poor belt tracking, baghouse fire / explosion propagating back to the elevators. Failure of the drive end clutch resulting in high temperatures. Flame will propagate to screw - chain conveyor and spread throughout the mill	Product and equipment fire, potential for internal dust explosion	Bearings are external. Belt drift / mis-alignment sensors. Aspiration system (with interlocks). Equipment designed to ATEX including hazardous area assessment. Foreign objects removed via screen and separators	Review the need for installing temperature sensors in the elevators for fire detection and/or the installation of deluge or fire suppression system (Inergen). Operator detection of issue required plus response, e.g. opening a valve to initiate the deluge. Check with Buhler / explosion experts the explosion prevention / protection measures for bucket elevators, e.g. explosion vents every 6 m as per NFPA for bucket elevators
2	Hazardous Zoning	Explosion	Static electrical explosions	Explosion - fire, loss of life, equipment damage, production downtime	Earthing of equipment, static bonding, preventative maintenance in hazardous areas	Check with Buhler that the belts and flights are anti-static

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
3	Whole Mill	Dust explosion	Loss of containment of dust within the building, e.g. failure of product lift pipe	Dust explosion within the building, loss of life, equipment damage, production downtime	Sealed process systems lowering the likelihood of leaks, aspirated system, instrument and electrics to hazardous zones, housekeeping. Permit to work system requiring adequate cleaning and control of ignition sources	None
4	Magnetic separators	Fire	Failure of magnets	Metal particles through the process - ignition source due to impact or friction	Daily checks, cleaned every morning	None
5	Aspiration system	Propagating explosion	Charged particles on the conveyor	Fire / explosion could propagate to other equipment, e.g. dust collectors	Design of process includes explosion vents on the dust collectors. Removal of ferrous materials via magnets	None
6	LAAB Cleaning Separator (Combi Cleaners)	Static explosion	Static electricity from product flowing over the four trays (vibrators and motors)	Static fire, causing explosion	All equipment is bonded and earthed	None

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
7	Hammermill	Fire / explosion	Foreign objects in the hammermill causing ignition which can propagate to the bin / dust collector or thrown hammer	Point of ignition for dust explosion is the hammermill. Injury to worker, production downtime due to equipment damage and product loss. Secondary explosion possible. Foreign objects can also block the hammermill feed chute	Magnet in location, temperature sensor, vibration switch and transmitter, level / flow sensor. Rotary airlock to dust collector. Interlocks on dust collector. Vents in the dust collector	None
8	Dust Collector	Explosion	Hammermill fire	Explosion - fire, loss of life, equipment damage, production downtime. Can also propagate backwards	Explosion vents in dust collector. Vacuum in line. Interlocks on loss of air flow through the dust collector	None

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
9	Rollers	Dust explosion	Broken roller, failed roller mechanism, failure of equipment	Dumping of product in front of inspection flap, i.e. flour pushed up the inlet chute and a loss of containment from choking of the system. Dust in the area that can settle on motors causing heat build-up. This can result in ignition of product from hot motor. Build-up of product on the roller that continues to roll. Overfill the inlet chute as above, heating of the flour due to the rollers and hence a possible smouldering fire	Covers over motor, high level switch, programmed maintenance every three months, housekeeping, testing of sensors to ensure sensitivity is suitable	None

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
10	Rollers / Impact Detacher (machines)	Hot surfaces	Normal running conditions (rollers running hot), back up failure, unable to segregate wheat products, relifts choke (unable to handle) and nothing going through (no product flowing) friction causing heat - internal ignition back up into rollers	Fire / explosion within the building. Potential for burn injury to worker	High level alarm, during staffed times - inspections every hour, housekeeping within the building, hazardous area zones	None
11	Rollers	Dust explosion	Foreign object within the rollers, e.g. failure of the magnets, or static	Dust explosion that can propagate to other equipment, downtime	Maintenance, inspections and housekeeping on the magnets. Procedures for checking particular items (ball bearings) source when they appear on the magnets. Regular walkthroughs during staffed hours would pick up noises in the rollers. Designed to ATEX standards	None

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
12	Detachers	Dust explosion	Foreign object (e.g. detacher pin release), plate contact within the detacher, static	Fire within the detacher which has the potential to propagate to the dust collector via the cyclone	Explosion vent on the dust collector, detacher earthed, magnet prior to the rollers	None
13	Detachers	Fire	Hand hold leak - gravity feed product (vacuum) product will settle on motor and hence will heat up (source of ignition)	Heat from motor causing fire hazard	Operators trained to replace inspection hatch covers, walkthroughs to detect abnormal conditions, housekeeping, hazardous area zones	None
14	Distributors - Cyclones	Dust explosion	High velocity impact / object	Propagate to dust collectors. Dust collector fills up with dust and product	High level switch stops the mill (dust collectors and filtered flour hopper). Magnets before the rollers, explosion vents on dust collectors, earthing and bonding	None
15	Sifters	Fire / Explosion	Mechanical / electrical problems, counter weight within sifter coming loose (1 te each), choke underneath one of the sifters leading to too much flour on one side of a sifter	Sifters out of alignment, structural damage to building, worn electrical cables due to excessive vibration which could lead to ignition	When the sifter motors stop, it will be alarmed and the Mill will trip, safety cables (16mm stainless cable) on the sifters, canes (nylon or timber) on each corner of sifter, rotation sensor on top of each of the sifters	None

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
16	Sifters	Explosion	Failure of connecting socks	Loss of containment of flour dust with potential of ignition - explosion in the building	Sensors on each of the bottom socks - if they disconnect - break the beam and stop the mill (bottom socks only - not the top socks). Walkthrough observations	None
17	Rotary Valves	Explosion	Surface ignition, e.g. from a foreign object	Potential for a fire / explosion	Magnets and screens	None
18	Hopper	Air pollution, water pollution	Loss of containment from equipment items outside the mill	Pollution - product could be blown off site	System is designed for product containment with high level trips	None
19	Transfer to Flour Bins	Loss of containment of product - enclosed area	High level switch failure on a bin	Overfill bins and the flour is blown into the aspiration lines to the dust collector which fills up and then escapes to the atmosphere via the air inlet line	High pressure trip on the blowers. Level sensor calibration	None

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
20	Dust Collectors	Explosion	Static, carryover spark. Propagation of fire event from elsewhere in the process, e.g. burning embers	Explosion	Earthing / bonding of all equipment. Hazardous area zones. The switches on the explosion vents stop the mill including the rotary seals to stop the explosion propagating. Induced draft which keeps the concentration kept below the LFL. All filters are pulsed with air for cleaning, pressure is measured and checked every day. If issues arise the socks are changed. The socks are also changed every 6 months. Anti-static socks	Review the need for check valves to stop flame propagation from the dust collectors to elsewhere in the plant
21	Dust Collector	Release of product	Failed sock	Product release	Visual detection, reporting from outside sources, replacement every 6 months - as above. LEL levels not reached, i.e. not considered to be an ignition risk	None

Event Number	Facility Area / Activity	Hazardous Event	Causes	Consequences	Existing Safeguards - Prevention Detection Mitigation	Additional Safeguards
22	Silos and bins	Dust explosions and fires	Static, foreign object, hot work	Confined dust explosion with damage to the silos and bins, potential for injury to people	All equipment containing dust are to be designed to ATEX standards. The mill is to be rated for hazardous zones including electrics and instruments are to be suitably rated and all equipment is to be bonded and earthed. Permits to work	None
23	Mill and silos	Flooding	Natural event involving significant rain fall	Potential for off-site environmental impact from material being swept away in the flood	The structural characteristics of the mill and silos will be certified by an engineer as capable of withstanding flooding and will not become unsafe during floods or as a result of moving debris that would potentially threaten the safety of people or the integrity of the structures	None

5 RISK ANALYSIS

The assessment of risks to both the public as well as to operating personnel around the modified mill requires the application of the basic steps outlined in Section 1. As per HIPAP 6 (Ref 2), the chosen analysis technique should be commensurate with the nature of the risks involved. Risk analysis could be qualitative, semi-quantitative or quantitative.

The typical risk analysis methodology attempts to take account of all credible hazardous situations that may arise from the operation of processing plants etc.

Having identified all credible, significant incidents, risk analysis requires the following general approach for individual incidents:

Risk = Likelihood x Consequence

The risks from all individual potential events are then summated to get cumulative risk.

For QRA and hazard analysis, the consequences of an incident are calculated using standard correlations and probit-type methods which assess the effect of fire radiation, explosion overpressure and toxicity to an individual, depending on the type of hazard.

In this PHA, however, the approach adopted to assess the risk of the identified hazardous events is scenario based risk assessment. The reasons for this approach are:

1. The distance from the mill to residential and other sensitive land users is large and hence it is unlikely that any significant consequential impacts, e.g. due to radiant heat from fires, from the facility will have any significant contribution to off-site risk; and

2. There are a limited number of process safety events. The main events of interest are dust explosions and fire events. Therefore, these are analysed in the remaining sections of this report.

The risk criteria applying to developments in NSW are summarised in Table 2 on the following page (from Ref 3).

Table 2 - Risk Criteria, New Plants

Description	Risk Criteria
Fatality risk to sensitive uses, including hospitals, schools, aged care	0.5×10^{-6} per year
Fatality risk to residential and hotels	1×10^{-6} per year
Fatality risk to commercial areas, including offices, retail centres, warehouses	5×10^{-6} per year
Fatality risk to sporting complexes and active open spaces	10×10^{-6} per year
Fatality risk to be contained within the boundary of an industrial site	50×10^{-6} per year
Injury risk – incident heat flux radiation at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50 chances in a million per year or incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year	50×10^{-6} per year
Toxic exposure - Toxic concentrations in residential areas which would be seriously injurious to sensitive members of the community following a relatively short period of exposure	10×10^{-6} per year
Toxic exposure - Toxic concentrations in residential areas which should cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community	50×10^{-6} per year
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m^2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50×10^{-6} per year

As discussed above, the consequences of the potential hazardous events are initially analysed to determine if any events have the potential to contribute to the above-listed criteria and hence worthy of further analysis.

5.1 DUST EXPLOSIONS

An analysis of the new equipment where potential dust explosions could occur is summarised below.

- Baghouse filters. Dust explosions are to be vented via explosion vents (both flameless and non-flameless);
- Bucket elevators, chain conveyors and screw conveyors. Note: low conveyor speeds and belt tracking with limit switches will be used to minimise the risk of ignition, and air purging to the baghouse filters is designed to keep the dust concentration below the lower explosive limit;
- Rollers / mills. These are to be designed as per the existing units;
- Sieves and sifter. These are to be designed to ATEX standards; and
- Aspiration and pneumatic conveying systems. These are to be designed to ATEX standards.

Modelling of the only new externally vented explosion vent is shown in Table 3. All other explosion vents are to be flameless. These results were derived as follows.

From Ref 7, the damage radius of a dust explosion is usually limited to the building (or equipment item) in which it occurs and to a very short range outside. This is supported by the historical incidents involving dust explosions where the majority of fatalities involve on-site personnel.

The majority of dust explosion incidents detailed in Ref 5 resulted in no fatalities. For the incidents where fatalities occurred, these were to on-site personnel. Again, the greater risk for fatality or injury for dust explosions is to on-site personnel as stated in Ref 7.

The maximum explosion overpressures at a distance D (m) from a vent or point of release is given by (Ref 8):

$$P_{blast} = (P_{max} \times C1 \times C2) / D$$

Where:

P_{blast} is the overpressure (or peak blast pressure) at a distance D from the vent, kPag

P_{max} is the pressure within the vessel when the vent opens or the rupture pressure of the vessel (if no vent installed), kPag

C1 = 10^((-0.26/A) + 0.49)

A = vent area, m^2

C2 = 1 m

D = distance away from the vent, m

The rupture pressure of weak structures such as silos is typically less than 90 kPag (Ref 5). This reference quotes one experiment where a 500 m^3 silo ruptured at 60 kPag with a hole size of 50 m^2.

To estimate the possible maximum horizontal flame length from a vented dust explosion, the following equation is used (Ref 8):

$$\text{Flame Length} = 10 \times V^{1/3} \text{ (m)}$$

Where:

V is the volume of the vessel, m^3

However, no flame length has ever been measured greater than 30 m (even for large volumes) so this should be taken as the upper limit (Ref 9). Other studies in Ref 9 also show that effects of thermal radiation from the fireball is limited to close to the fireball's surface given the short duration.

Importantly, the proposed explosion vents must therefore be directed to a safe location to avoid injury to personnel or propagation to other adjacent equipment.

Table 3 - Dust Explosion Modelling Results

Equipment	Rupture Pressure, kPag	Volume, m^3	Vented Inside or Outside the Building	Vent Area, m^2	Flame Length, m	Distance (m) to the Selected Overpressures:		
						21 kPa	**14 kPa**	**7 kPa**
Filter, MVRT 39/30	10	2.04	Outside	0.2	13	-	-	<1

Note: This explosion vent is positioned at the top of the flour mill building and vents to atmosphere where there are no other equipment items, i.e. no risk of propagation.

The effects of explosion overpressures are summarised in the following table (Ref 3).

Table 4 – Effects of Explosion Overpressures

OVERPRESSURE, kPa	PHYSICAL EFFECT
3.5	90% glass breakage No fatality, very low probability of injury
7	Damage to internal partitions & Joinery 10% probability of injury, no fatality
14	Houses uninhabitable and badly cracked
21	Reinforced structures distort, storage tanks fail 20% chance of fatality to person in building
35	Houses uninhabitable, rail wagons & plant items overturned. Threshold of eardrum damage, 50% chance of fatality for a person in a building, 15% in the open
70	Complete demolition of houses Threshold of lung damage, 100% chance of fatality for a person in a building or in the open

Given the estimated impact distances in Table 3, the height of the release and the distances to off-site areas from the new flour mill equipment then no significant off-site impacts are expected from explosion overpressures or radiant heat from flames. Therefore, the risk criteria shown in Table 2 will be satisfied for potential dust explosions within equipment.

5.2 Building Explosions

It is possible that dust explosions could occur in the mill building, e.g. deposited dust is not removed due to failure of the housekeeping program. This hazard exists at the site now for the existing flour mill.

The primary means to prevent this event is to design for containment, i.e. do not release combustible dust into the building. This is the basis for the design of the existing flour mill and will be similarly for the new flour mill equipment.

Should losses of containment of combustible dust occur then controls such as housekeeping, hazardous zoning and permits to work are required. These are discussed in more detail in Section 5.4 but are important measures to lower the risk of dust explosions within the existing building. As this hazard exists now on-site and the new equipment is being designed to the same standard as the existing equipment then no further safeguarding is recommended for this scenario.

5.3 DUST EXPLOSION SAFEGUARDING

For equipment processing a potentially explosive dust, it is generally not possible to always ensure the concentration of the dust is below the lower explosive limit. Rather, safeguarding is required to prevent and/or control the potential explosions as discussed below.

There are no mandatory standards or regulations that dictate the design criteria and features for equipment where dust explosions can occur. However, the main means for safeguarding against dust explosions are as follows.

A discussion of the proposed safeguards for the new flour mill equipment is included at the end of this Section.

5.3.1 Dust Free Process

Inherently safer options include operating with the materials being wet rather than dry, i.e. preventing dust formation. Not all processes are suited to this option though, e.g. wheat grains, as self-heating can occur and degradation of the grain can occur. For a mill, this is not an option.

5.3.2 Dust Control

Measures to control dust and avoiding the explosive range include:

- Avoid large volumes as much as possible, e.g. to avoid equipment items running empty;
- Avoid dust formation by limiting the free-fall;
- Remove the dust at the point of production rather than convey it along ducts where it can accumulate;
- Buildings which contain plant handling flammable dusts should be designed to minimise the accumulation of dust deposits and to facilitate cleaning; and
- Regular housekeeping to avoid dust build-up.

5.3.3 Control of Ignition Sources

Measures used to control ignition sources which could give rise to dust explosions include:

- Avoid direct fired equipment;
- Bonding and earthing for static dissipation;
- Permits to work, training and auditing;
- Regular housekeeping to avoid dusts overheating, e.g. on hot surfaces;
- Hazardous area determination with compliant electrics and instruments;
- Preventative maintenance on equipment to minimise the probability of fault conditions;
- Use appropriate electrical equipment and wiring methods;
- Control smoking, open flames, and sparks;

- Avoid the possibility of a thermite reaction, e.g. aluminium reacting with iron oxide;
- Use separator devices to remove foreign materials capable of igniting combustibles from process materials; and
- Separate heated surfaces and heating systems from dusts.

5.3.4 Inerting

The suspension of a combustible dust in air may be rendered non-explosive by the addition of an inert gas. The main gases used for inerting of dust handling equipment are nitrogen, carbon dioxide, flue gas and inert gas from a generator, e.g. argon or helium.

Inerting by adding an inert dust is another means to prevent dust explosions. This is mainly done in mining, e.g. coal dust is mixed with ground stone to render the coal dust non-explosive.

5.3.5 Explosion Containment

One option for dealing with a dust explosion is total containment, i.e. design the equipment to withstand the maximum generated pressure. For dust explosions, the maximum generated pressures are quoted as 7 to 12 barg for atmospheric processes or up to 12 times the initial pressure in the equipment item. Hence, if the equipment has a design pressure equal to or exceeding these values then the explosion will be contained with no flames being emitted. Grinding mills are an example of such equipment items which may be made strong enough to withstand a dust explosion.

5.3.6 Explosion Isolation

The two basic methods for explosion isolation are:

- Automatic isolation, e.g. a pressure sensor will send a signal to a fast closing valve to shut and isolation the equipment item or pipe; and
- Material chokes such as rotary valves, screw conveyors with baffle plates and/or part of the helix removed to prevent the conveyor emptying on no feed flow, and self-actuating float valves 9non-return valves).

5.3.7 Explosion Suppression

Typically an increase in operating pressure is detected (e.g. pressure rises to 5 kPag) which then results in a suppressant being injected into the equipment item to suppress the flame. By suppressing the flame early, the pressure rise is limited. Suppressants include dry powder and water.

5.3.8 Explosion Venting

Explosion venting is an effective and economic way to provide protection against dust explosions, however, it is only suitable if there is a safe discharge for the material being vented. For equipment within a building, ducting the vent to outside should be done provided it is short, e.g. less than 10 m (detonations can occur in pipes of 10 to 30 m in length).

5.3.9 Equipment Separation

It is possible that an explosion from one equipment item or building could propagate to another. This could be via secondary explosions due to dust lifting and forming a cloud or from projectiles embedding into thin-walled equipment and hence being a point of ignition due to heat. If layout considerations permit, adequately separately higher risk process items or buildings is an inherently safe option.

In practice (Ref 5), the assessment of dust explosion hazards is bound to be subjective because the problem is too complex for quantitative analytical methods to yield an indisputable answer. Therefore, the acceptable safeguards for any given design will vary from company to company. Ref 5 quotes work by Pinkwasser and Haberli who suggest most of the dust explosion hazards in the grain, feed and flour industry can be eliminated by soft means such as training, motivation, improving the organisation, good housekeeping and proper maintenance. All of these safeguards are in-place at Shoalhaven Starches.

When these are combined with the additional measures proposed for the new equipment then further risk reduction is achieved. These additional measures include all equipment handling potentially explosive dust is to be designed to ATEX standards including rotary valves for seals, explosion vents (flameless to be used as much as possible), interlocks, metal traps to minimise the risk of ignitions in the mills, equipment bonding and earthing, minimisation of horizontal surfaces in the buildings where dust can collect, screw feeders to contain plugs to prevent flame propagation and hazardous area zoning with the electrics and instruments to suit the requirements.

5.4 FIRES

As stated in Table 1, it is possible to ignite the combustible material involved in the process, i.e. grain or dust, if a strong ignition source is present.

Fires have occurred previously with these types of processes and are typically of a smouldering nature given the moisture content of the material and confinement within silos and other equipment. The moisture content is typically 10 to 12%.

From Ref 7, fires involving flammable or combustible powder are not believed to place the public at risk but could be a threat to employees.

Given that the new mill equipment is approximately 120 m away from Bolong Road then the risk criteria in Table 2 will be satisfied.

5.5 AIRCRAFT IMPACT AND OTHER EXTERNAL EVENTS

Previous risk assessments (e.g. Ref 10) have shown that the likelihood of an aircraft crash is acceptably low within Australia. Typical frequencies associated with aircraft crashes are:

- Scheduled aircraft $1x10^{-8}$/year; and
- Unscheduled aircraft $4x10^{-7}$/year.

The likelihood of this type of event is acceptably low for a site of this size and location.

Other external events that may lead to propagation of incidents on any site include:

Subsidence	Landslide
Burst Dam	Vermin/insect infestation
Storm and high winds	Forest fire
Storm surge	Rising water courses
Earthquake	Storm water runoff
Breach of security	Lightning
Tidal waves	

These events were reviewed and none of them were found to pose any significant risk to the new facility given the proposed safeguards. Flooding can occur at this site, however, the structural design for the existing flour mill building includes allowances for this hazard.

5.6 CUMULATIVE RISK

As shown in this PHA, the proposed changes to the Shoalhaven Starches site will have negligible impact on the cumulative risk results for the local area as the significant radiant heat levels and explosion overpressures are local to the equipment.

Therefore it is reasonable to conclude that the development does not make a significant contribution to the existing cumulative risk in the area.

A review of the potential propagation risks both from and to the modified mill was conducted.

There is only one new explosion vent that vents externally to the building (all other explosion vents are flameless). The external explosion vent points east from the top of the existing flour mill building. From Table 3, the estimated flame length is approximately 13 m. There no other structures that this vent could impact at this height.

For this externally vented explosion vent, the distance to 7 kPa is less than 1 m (it is for a small baghouse filter only). Therefore, propagation due to explosion overpressures is not expected.

Should the combustible dust containment systems fail in the existing or new equipment and the safety management systems, e.g. equipment not rated to the hazardous zones, also fail then ignition can occur with a dust explosion within the building. This could cause damage to the adjacent structures as well. As discussed in Section 5.2, building dust explosions in mills is a known hazard and both hardware (e.g. design for containment and electrics and instruments rated for hazardous zones) and safety management systems (e.g. housekeeping) are required to lower the risk to an acceptable level. These measures are used in the existing mill to lower the risk of propagation.

5.7 SOCIETAL RISK

The abovementioned criteria for individual risk do not necessarily reflect the overall risk associated with any proposal. In some cases for instance, where the 1 pmpy contour approaches closely to residential areas or sensitive land uses, the potential may exist for multiple fatalities as the result of a single accident. One attempt to make comparative assessments of such cases involves the calculation of societal risk.

Societal risk results are usually presented as F-N curves, which show the frequency of events (F) resulting in N or more fatalities. To determine societal risk, it is necessary to quantify the population within each zone of risk surrounding a facility. By combining the results for different risk levels, a societal risk curve can be produced.

In this study of the modified mill, the risk of fatality does not extend significantly from the equipment and is therefore well away from the residential areas. The concept of societal risk applying to residential population or other off-site receptors is therefore not applicable for the modified mill.

5.8 RISK TO THE BIOPHYSICAL ENVIRONMENT

The main concern for risk to the biophysical environment is generally with effects on whole systems or populations.

As there are no Dangerous Goods associated with the modified mill, significant environmental impact is not expected. Whilst fires can also effect the environment due to combustion products, these events are low likelihood given the history of these types of processes. Importantly, any spilt material will be contained in the area or via the environmental farm.

Whereas any adverse effect on the environment is obviously undesirable, the results of this study show that the risk of losses of containment impacting the environment is broadly acceptable.

From the analysis in this report, no incident scenarios were identified where the risk of whole systems or populations being affected by a release to the atmosphere, waterways or soil is intolerable.

5.9 TRANSPORT RISK

There are no Dangerous Goods involved with the modified mill.

Currently, wheat is delivered to the site four times per week in rail hopper cars nominally of 60 tonne capacity. Each train delivers approximately 2,100 tonnes of wheat.

The expansion will require an additional 3,375 tonnes per week of wheat grain to feed the modified flour mill, i.e. approximately an extra three trains every two weeks.

This will be offset, however, by a reduction in the amount of flour exported (2,700 tonnes per week) to the Company's other flour mills, i.e. a reduction in the amount of flour leaving Shoalhaven Starches being the equivalent of just more than one train carrying flour per week. The net effect of this is an overall increase in rail freight of up to 675 tonnes per week to the site.

Given this low frequency impact for a non-Dangerous Good (i.e. wheat grain), transport risk is deemed broadly acceptable.

6 CONCLUSION AND RECOMMENDATIONS

The risks associated with the proposed modified flour mill at the Shoalhaven Starches Bomaderry site have been assessed and compared against the DoP risk criteria.

In summary:

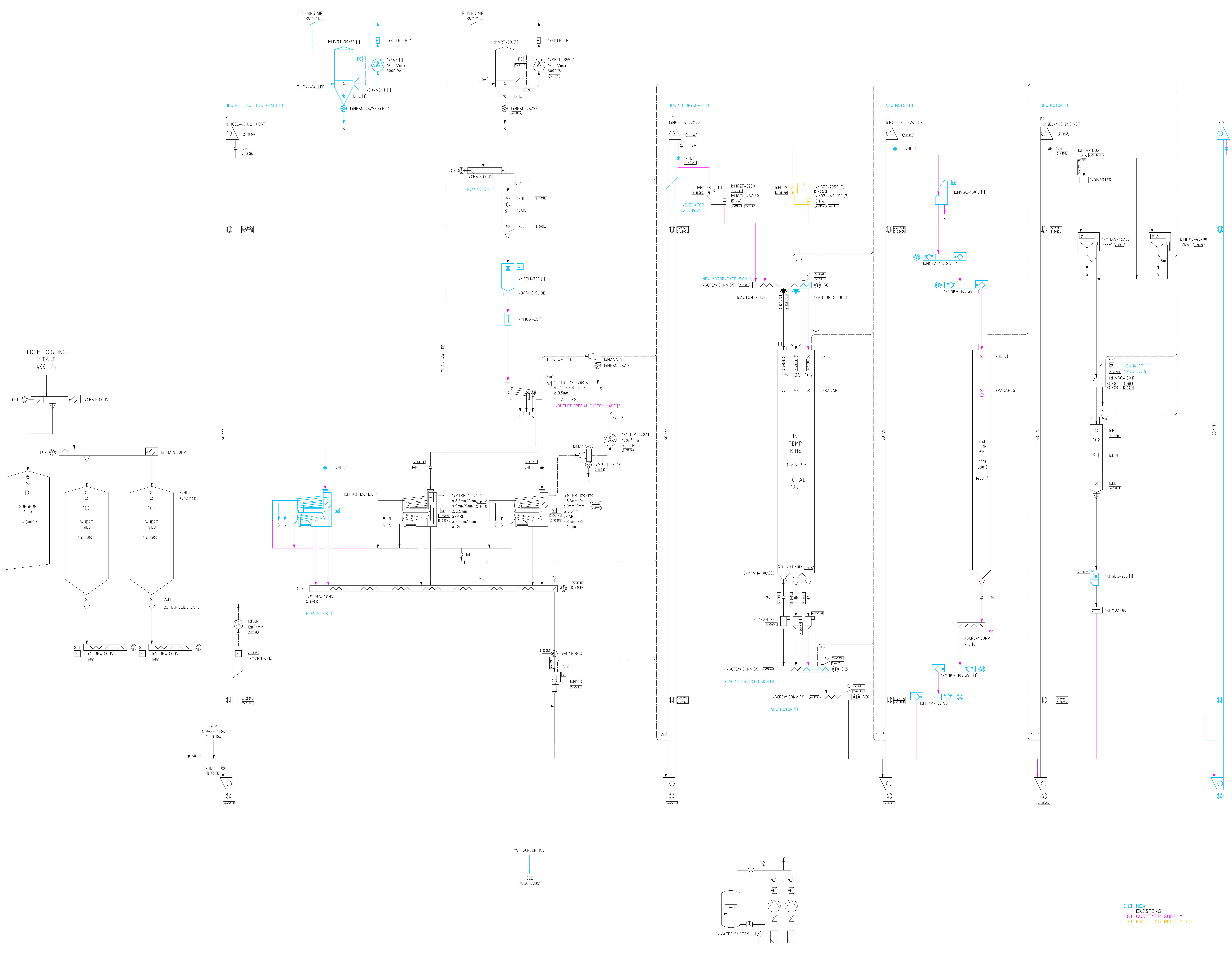
- The potential hazardous events associated with the modified flour mill are dust explosions and smouldering fires. Given the nearest public land is approximately 120 m away and the river is 20 m away and the equipment is explosion protected well above ground level then no adverse off-site impacts are expected;
- All risk criteria in HIPAP 4 is expected to be satisfied for this development;
- Propagation to neighbouring equipment is not expected given that the potential dust explosions are either to be vented to atmosphere at a safe, elevated location or of limited consequential impact and the potential fires are of a smouldering nature; and
- Societal risk, environmental risk and transport risk are all considered to be broadly acceptable.

The recommendations included in the Hazardous Event Word Diagram (Table 1 in this report) will require addressing as part of the design for the modified flour mill. There are no other recommendations from the assessment performed in this PHA.

Appendix 1

Process Flow Diagrams

Preliminary Hazard Analysis, Shoalhaven Starches, Alterations to the Existing Flour Mill



REV.	APPD. DATE	DESCRIPTION	DRAWN BY	APPD. BY	ISSUED BY
01	04.06.2015	FADE OUT TECHN-TEXT ACCORDING TO G. SCHAFLER / GM6	M. Aberer	G. Schafler	

PLANT OWNER :
MANILDRA GROUP
NOWRA / AUSTRALIA

CONTRACTOR :

PROJECT : PRODUCT / CAPACITY:
1ST + 2ND CLEANING
HARD WHEAT / 60 t/h / 53 t/h

TITLE :
CAPACITY INCREASE TO 1250t/24h

ISSUE FOR: State 00

Drawn	P. Degrange	GM613	07.05.2015	Contract No.	MU-15--	Project No.	
Approved	G. Schafler	GM6	04.06.2015	Replace Drawing No.		Replaced by Drawing No.	
Issued				Plant Owner Drawing No.			

Bühler AG
CH-9240 Uzwil/Switzerland
BÜHLER

Scale %
Drawing-Number MUDC-68412
Revision 01
CAD DIN A0

ROLLER LENGTH

BK - PASS. 40.00m = 3.20mm/100kg/24h
C - PASS. 43.00m = 3.44mm/100kg/24h

TOTAL 83.00m = 6.64mm/100kg/24h

SIFTER SURFACE = 0.025m²/100kg/24h

FINISHED PRODUCTS

FLOUR < 250µ

BRAN (MILLMIX)

MACHINE LIST:

2x MDDQ-1250/250	[7]
3x MDDQ-1250/250	[1]
8x MDDQ-1250/250	
2x MDDL-1250/250	
2x MDDL-1000/250	
2x MPAG-824	
2x MPAK-824	
1x MPAK-424	[1]
6x MJZF-51-15-3000	
6x MJZF-51-15-3000	[1]
2x MJZE-43-5.5-3000	[7]
3x MJZE-43-5.5-3000	
2x MKZH-6012 B	[1]
1x MKLA-45/110 D	[1]
5x MKLA-45/110 D	
3x MKLA-45/110	
1x MZVE-330 WITH MAGNET	
6x NEW PAIR OF SMOOTH ROLLS	[6]

ACCESSORIES:

x AUTOM. FLAP BOX	[1]
2x MANUAL FLAP BOX WITH LS	[1]
9x SENSOR (PN LIFTS / SPOUTING)	[1]
2x SPEED SENSOR FOR PN AIRLOCKS	[1]
x ROLL TEMP. MONITORING FOR MDDP/Q	[1]
x BEARING TEMP. MONITORING FOR MDDP/Q	[1]
x DIRECT PICK-UP FOR MDDP/Q	[1]
x AUTOM. ROLL GAP ADJUSTEMENT FOR MDDP/Q	[1]
1x OUTLET PIPE MONITORING FOR MPAK	[1]
1x LEVEL MONITORING FOR MPAK	[1]
1x ANALOG PRESSURE SENSOR PNEUMATIC	[1]
3x REMODELING SIEVE STACK	[1]
5x SIEVE STACK NOVA (WOOD)	[1]
100x SIEVE FRAME WITH COVER	[1]
3x NEW SIEVE MKLA	[1]

[1] NEW
EXISTING
[6] CUSTOMER SUPPLY
[7] EXISTING RELOCATED

REV.	APPD. DATE	DESCRIPTION	DRAWN BY	APPD. BY	ISSUED BY
01	04.06.2015	FADE OUT TECH TEXT	V. Schulte	G. Schafler	

PLANT OWNER : MANILDRA GROUP NOWRA / AUSTRALIA

CONTRACTOR :

PROJECT : PRODUCT / CAPACITY: MILL HARD WHEAT / 1250 t/24h

TITLE : CAPACITY INCREASE TO 1250t/24h PROPOSAL 1

ISSUE FOR:

State 00

Drawn	P. Degrange	GM613	07.05.2015	Contract No.	MU-15--	Project No.	
Approved	G. Schafler	GM6	04.06.2015	Replace Drawing No.		Replaced by Drawing No.	
Issued				Plant Owner Drawing No.			

Bühler AG
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Scale %

Drawing-Number MUDC-68413

Revision 01

CAD DIN A1


RINSING AIR FROM MILL
1xMHTP-MXE 031 009030-00 [1]
95 m³/min
2790 Pa
1xMVRS-39/24 [1]
1xPN. HAMMER [1]
1xAIR LOCK [1]
1xDN-160 [1]
1xMHTP- [1.1]
60 m³/min.
2500 Pa
5.5 kW
1xMVRU-15/24
56.0 m³
4.0 m³
1xPN. HAMMER
1xMPSN-25/15
0.55 kW
4xMNRA-250
1xMHGL-630/440 [1]
- 72.0 t/h
1xMNKA-200 [1]
- 72.0 t/h
8xHL [2]
1
5
2
6
3
7
4
8
600 m³
300 t
8xMFVC-160/500
8xLL[2]
3xBULKNET (A)
7xMNSG-200 (B)
4xMNSG-250 (C)
MILL "A"
1250 t/24h
ASP. MILL
FLOUR 42.0 t/h
1xMNKA-100 [1]
1xMEAG
1xMYTA
1xWIN POM (STAND ALONE) OR INTEGRATED IN WINCOS
1xHL [1]
1xMWBO-350/250M [1]
1xMNKA-100 [1]
MILL "B" [5]
750 t/24h
29.0 t/h
1xMNKA-200 [1]
- 72.0 t/h
1xBLOWER
1xFAN
1xMVRN-4/8
1xHL
1xAIRLOCK
1xFILTER
1xAIRLOCK NUCON
1xGMa-14.12
1xMVRN-4/8
1xMPSE-60/60
BL01 30 t/h
BL02 30 t/h
Gib es von BL02 eine alte Berechnung, damit könnte man schauen ob auch alles zusammen passt?
1xTKV-010
10 m³/min
1xMVRU-6/12
1xKIE-3015
1xMPSH-45/45
1.1 kW
BL06 30 t/h
1xGM-35 S
37 m³/min
90 kW
1xCOMPRESSED AIR UNIT
4xØ 250
2xMAYH-200
2xMAYH-200
4xHL
160 m³
80 t
4xMFVC-160/500
4xLL
4xMNSG-200
4xFC
1xMVRN-4/8
1xMPSE-45/45
1xBLOWER
BL03 30 t/h
BL04 30 t/h
BL05 25 t/h
2xMAND-70/16-45
2xHL
2xMKZF-40/90 E
Ø 6.0 mm
2xMHTM-22.08
2200 Pa
2xMVRS-18/24
1xHL
30 t
1xLL
1xMFVC-160/600
3xMNSG-200
4 m³
3xMWBO-170
1xMNSG-200
3xMMUD-20
3xHL
STARCH PLANT FUNKEN 1 - 2 - 3
3x18 t/h
20 t
1xVIBR
1xTU
STARCH PLA FUNKEN 4
1x20 t/h

TO MILL ASP.
5 m³
MILLMIX - 13.0 t/h
1xNFAS-315
3 kW
SC12
1xTRANSMISSION [1]
1xMOT. [1]
1xHL
6-300HL
6-450WE
1xMSDL-240 [7] (EX. FLOUR SCALE)
1xHL [7]
6-303HL
1xMZDG-62/50 [7]
0.75 kW
6-M040
6-420TE
1xFC [7]
SCREENINGS - 1.5 t/h
SEE MUDC-68351
1xFAN [7]
6-M030
6-250FC
1xMVRN-6/8 [7]
6-380PS
1xHL [7]
6-302HL
1xMPSH-45/45 [7]
6-M020
15.0 t/h
BL06
1xGMa-13.6
20.2 m³/min
6-M010
BULK TANKER INTAKE
GROUND SCREENINGS
FROM SORGHUM PLANT
1 t/h
1xSILENCER
ACCORD
1xSW-315.10
90 m³/min
3561 Pa
11 kW
1xMVRT-18/30
1xHL
1xRADAR
DAY BIN
2
30 t
1xSIMON 2000/500
1xLL
1xMNSG-200
3 kW
1xFC
8 m³
1xHL
1xGM-35 S
34 m³/min
75 kW
1xMPSH-45/45
1.1 kW
1xMAYH-170
12 t/h
1xMAYH-170
1xFAN
90 m³/min
3550 Pa
11 kW
1xMVRT-18/30
1xHL
10 t
TO DDG DRYERS
1-2-3
1xHL
1xGM-35 S
34 m³/min
75 kW
1xMPSH-45/45
1.1 kW
12 t/h
1xMAYH-170
DDG
FROM PALMER COOLER
1xSIMON
1000/250
1xHL
1xGM-30 L
26 m³/min
30 kW
1xAIRLOCK
FILTAIRE 250
22 min¹
.... kW
.... t/h
1xHL
1xGM-30 L
26 m³/min
30 kW
1xAIRLOCK
FILTAIRE 250
22 min¹
.... kW
.... t/h
1xHL
1xGM-30 L
26 m³/min
30 kW
1xAIRLOCK
FILTAIRE 250
22 min¹
.... kW
.... t/h
1xCYCLONE
1xSW-315.10
90 m³/min
3550 Pa
11 kW
1xFILTER
HOSOKAWA- MIKROPUL
19W-10TR-20
1xHL
1xAIR LOCK
1xFAN
.... m³/min
.... Pa
.... kW
1xFILTER
1xHL
1xAIR LOCK
1xFLAP BOX
1xFAN
.... m³/min
.... Pa
.... kW
1xFILTER
1xHL
1xAIR LOCK
1xFLAP BOX
1xFAN
.... m³/min
.... Pa
.... kW
1xFILTER
1xHL
1xAIR LOCK
1xFLAP BOX
1xSCREW CONVEYOR
.... kW
1xSCREW CONVEYOR
.... kW
WATER
1xBLENDER
510 min¹
18.5 kW
TO DDG
STORAGE SHED
1xELEVATOR
.... t/h
30 m³
1xLOADING SPOUT
MECAL- M750x3.5m
CL
1xELEVATOR
75 t/h
15 kW
15 m³
1xKIE-
42 m³
1xCYCLONE
10 m³
1xHL
1xCHAIN CONVEYOR
90 t/h
7.5 kW
1xDOSING WHEEL
0.55 kW
1xFC
PEL
8 m³
1xHL
1xGM-35 S
32 m³/min
45 kW
1xMPSH-45/45
1.1 kW
12 t/h
1xSILENCER
1xFAN
150 m³/min
2500 Pa
15 kW
1xMVRU-32/24
1xHL
1xPN. HAMMER
1xMPSN-25/23
0.55 kW
5 m³

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ANNEXURE 8

ANNEXURE 8

Traffic Impact Assessment

prepared by

ARC Traffic & Transport

Shoalhaven Starches, Bomaderry

Flour Mill Modification Proposal

Traffic Impact Assessment

September 2015

prepared for

Manildra Shoalhaven Starches

prepared by

ARC Traffic + Transport

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Introduction

Shoalhaven Starches Pty Ltd (Starches) propose modifications to the existing Flour Mill located within the Shoalhaven Starches Site, Bolong Road Bomaderry (the Site) to increase the amount of flour that will be able to be produced on the SS Site (Proposal). The Proposal involves the installation of additional plant within the confines of the existing Flour Mill only.

From the outset, the Proposal would not increase staff requirements, nor heavy vehicle trip generation; as importantly, the very moderate additional rail freight demand arising from the Proposal would be accommodate using existing train capacity, and as such not increase the number of trains, nor duration of train crossings, at the Bolong Road level crossing. The only significant potential for the Proposal to impact the local transport environment would be during what would be a short two month construction period.

ARC Traffic + Transport (ARC) has been commissioned to examine the access, traffic and parking issues associated with the Proposal. To appropriately examine the Proposal, this Traffic Impact Assessment references recent reports prepared by ARC in regard to the operation of the Site, and the broader local traffic environment. Specifically, ARC has referenced the following past reports: -

- Shoalhaven Starches Access Review 2014
- Shoalhaven Starches Ethanol Upgrade & Packaging Plant Traffic Impact Assessment May 2008

ARC has also referenced advice (10th September 2015) provided by the Department of Planning & Environment in regard to the traffic assessment requirements required in regard to the Proposal, specifically: -

> *Traffic – assess the potential increase in rail and/or road traffic from the modification, including daily trip numbers, assess predicted impacts on the safety and capacity of the rail and road network including consideration of cumulative traffic impacts, detail any infrastructure upgrades required or any other measures to minimise traffic impacts.*

1 The Existing Site & Flour Mill Operations

1.1 Location

The Site is located on the southern side of Bolong Road, Bomaderry, generally extending east from the intersection of Bolong Road & Railway Street through to the former Dairy Farmers Site (DF Site) which now forms part of the broader Site operations.

1.2 Existing Flour Mill Operations

In October 2007, Project Approval MP 07_0021 was granted by the NSW Government for the construction of a Flour Mill on the Site; the Flour Mill was subsequently constructed and is currently operating in accordance with the Project Approval. Wheat is transported directly to the Site by rail and processed in the Flour Mill into industrial grade flour for use in the production of starch and gluten per other approved operations within the broader Site, while the husk (mill feed) material resulting from the processing of wheat is then able to be used in the approved on-site DDG dryers. As a result of these operations, the equivalent amount of flout and mill feed was no longer needed to be transported to the Site.

The Flour Mill currently produces and processes approximately 5,000 tonnes of industrial grade flour per week, producing some 265,000 tonnes per annum of industrial grade flour for use across the Site. 15,000 tonnes of flour per week is approved to be transport to the Site by rail from Manildra's (other off-site) flour mills for uses in the production process in conjunction with the flour that is presently milled on-site (5,000 tonnes per week) providing a total approved flour processing capacity of some 20,000 tonnes per week.

1.3 Access

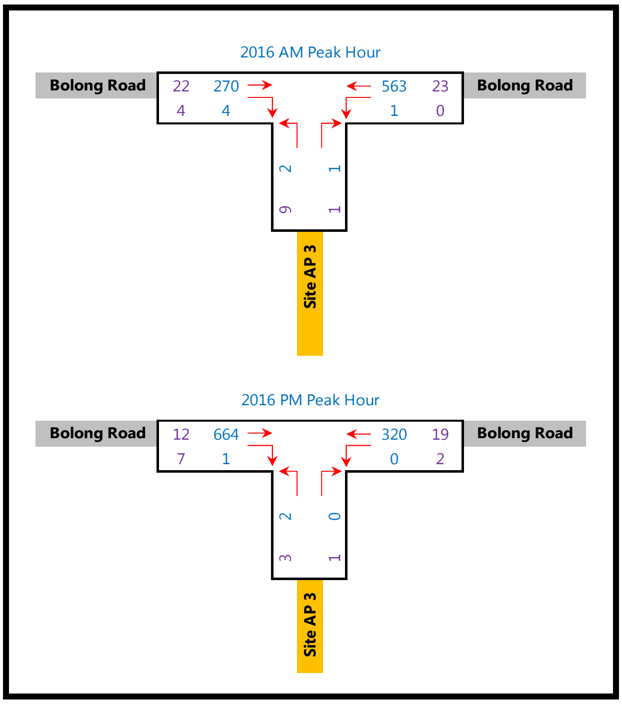
Access to the broader Site is provided via numerous access driveways, all to Bolong Road. Construction trips associated with the Proposal would be generated to a single access point – the Western Access Point, also referred to in previous ARC assessments of the Site as Access Point 3 (AP3), immediately west of the Cleary Brothers site on Bolong Road. AP3 is the subject of the assessment provided in sections below.

1.4 Traffic Operations

Further to consultation with Shoalhaven City Council (Council) ARC has over numerous years prepared traffic generation forecast for Bolong Road and the numerous Site intersections that reflect peak Site traffic flows, and 120th Highest Hour traffic flows in Bolong Road; these flows were referenced in recent reports by ARC relating to the Site.

With reference to the Access Review assessment, 2016 forecast AM and PM peak hour flows at the intersection of the Bolong Road & AP3 are provided in Figure 1.3.

Figure 1.3 2016 Forecast Flows Intersection Bolong Road & Access Point 3



SIDRA analysis of these 2016 forecast conditions indicates that the intersection operates at a good Level of Service (LoS) 'B' in both peak periods (with the only delay being to the minor right turn demand AP 3 to Bolong Road) and with minimal queue lengths and significant spare capacity.

2 The Proposal

2.1 The Proposal

As discussed, Starches propose modifications to the existing Flour Mill located within Site to increase the amount of flour that will be able to be produced on the Site.

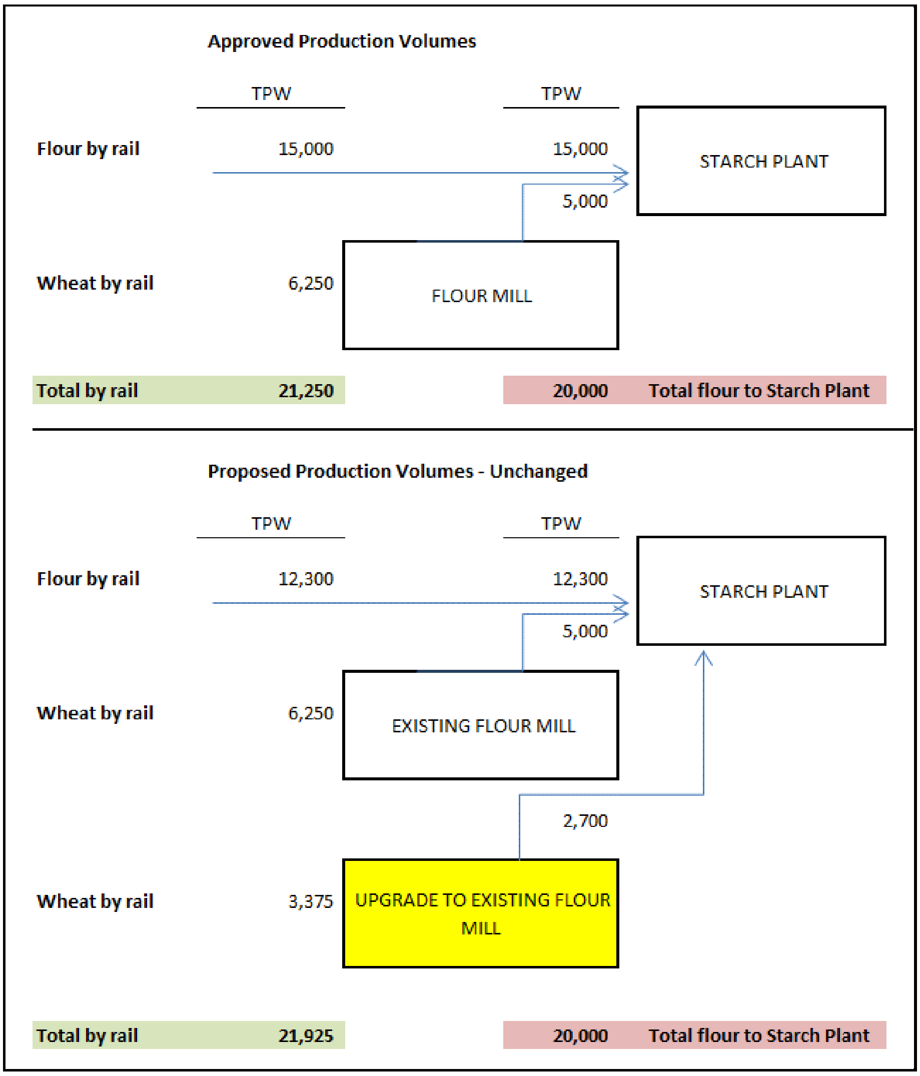
The Modification Application for the Proposal is pursuant to Project Approval MP06_0228 (Expansion PA) which was granted by the Minister for Planning on the 28th January 2009 for the Shoalhaven Starches Expansion Project (the Expansion Project). The Expansion PA encapsulates previous Site approvals into one overall approval, with the Expansion Project being a 'transitional Part 3A Project' for the purposes of Schedule 6A of the Environmental Planning & Assessment Act.

As stated, the Expansion PA also consolidated all previous approvals (up to that time) into the one Project Approval. For the purposes of this Proposal, this included Project Approval MP 07_0021 (October 2007) which enabled the establishment of the original Flour Mill on the Site.

The modifications will result in an increase in flour that will be able to be produced on-site by some 2,700 tonnes per week, to a total of 7,700 tonnes per week. Annually, total flour production would increase from the currently approved limit of 265,000 tonnes to 400,000 tonnes, though importantly the total amount of flour used in the production processes across the Site will remain within the approved 20,000 tonnes per week limit. The modifications would also enable spare capacity at other (off-site) Manildra flour mills to be dedicated to the production of higher grade flour.

The difference between the existing (approved) rates of flour processing and proposed rates further to the modification are shown in Figure 2.1.

Figure 2.1 Modification Application Throughput Proposal



With reference to Figure 2.1, an additional 3,375 tonnes per week of wheat grain will be required to feed the modified Flour Mill. However, this increase would be offset by a reduction in the amount of flour received (2,700 tonnes per week less) for other (off-site) Manildra Flour Mills. The net effect of the modification is an overall increase in rail freight of some 675 tonnes per week to the Site.

2.2 Operational Transport Impacts

2.2.1 Operational Traffic Generation

Once constructed and operational, the Proposal would not generate any additional staff or [product carrying] heavy vehicle trips over levels approved as part of the Expansion PA, but rather simply form part of the existing Flour Mill operations at the Site.

2.2.2 Rail Increases

An average of 7 flour trains access the Site weekly, generally being 1 flour train per day. At present, there is significant spare capacity within the trains, capacity which would more than accommodate the additional demand further to the Proposal. As such, there is no proposal to increase rail movements or the length of trains (and therefore crossing time) at the Bomaderry railway crossing over current approved levels.

2.3 Construction Traffic Impacts

The only period during which the Proposal would generate additional vehicle trips to the local road network would be during construction.

2.3.1 Construction Schedule & Requirements

The construction phase is estimated to occur over approximately 2 months, consisting of a month long construction (additional penetrations and structural support) phase and then a month long mechanical installation phase, and would require: -

- Up to 20 construction staff on-site daily (through both phases)
- Up to 2 construction material carrying heavy vehicles per day for the first month of construction

2.3.2 Construction Access

All access to the construction area will be via AP3, which loops to the rear of the Site and provides direct and immediate access to the existing Flour Mill.

At the intersection of Bolong Road & AP3, the majority of staff trips, and all heavy vehicle trips, are expected to travel to/from the west.

2.3.3 Construction Traffic Generation

During the construction of the existing Flour Mill, specialist staff were transport to and from the Site daily by mini-bus, and it is expected that staff for the construction and mechanical installation phase would travel in an identical manner.

Allowing for a small number of ancillary light vehicle trips on a daily basis, the daily generation of the construction and mechanical installation phase is estimated to be no more than 20 [light and heavy] vehicle trips per day.

In the existing peak periods – which could coincide with the arrival and departure peaks of staff and some of heavy vehicle trips [though unlikely given early construction start times] - the peak hour generation of the construction phase is estimated to generate no more than 2 - 3 vehicle trips per hour.

2.3.4 Construction Traffic Impacts

It is in our opinion immediately apparent that the construction phase will have little if any significant impact on the local road network simply as a factor of the minimal generation and short duration of the construction phase.

At key intersections to the west and north-west, the construction phase would generate perhaps 3 additional vehicles per hour, a level of generation that would in no way affect key intersection performance indicators. At the intersection of Bolong Road & AP3 where the construction trips are concentrated, SIDRA analysis indicates that the additional trips would have no impact on forecast base intersection operations, with existing [minor] delays, queue lengths and capacity barely affected.

In summary, the trip generation of the construction phase of the Proposal would have no impact on the local traffic environment or on existing on-site operations.

2.3.5 Construction Management

Notwithstanding the findings above, it remains that the case that the construction phase will need to be governed by an appropriate set of management procedures.

In relation to access, traffic and parking requirements during the construction phase, ARC recommends the following initiatives, which essentially mirror the Construction Traffic Management Plan (CTMP) requirements determined by ARC for the construction requirements of past Site projects: -

- All parking for construction staff and construction heavy vehicles will be contained within an appropriately secure on-site environment so as not to impact or be impacted by existing Site operations; or on the off-site traffic environment. Such spare parking capacity is available in the immediate area of the Flour Mill.

- While it is not anticipated that Restricted Access Vehicles (RAVs) will be required as part of the construction task, it is nonetheless the case that any such vehicles would be required to utilise the existing approved RAV route between AP3 and the Princes Highway via Bolong Road; access for such vehicles via the Railway Avenue bridge is not to be provided.

- Construction work hours are generally between 6:00am/7:00am and 5:00pm/6:00pm Monday to Friday, with an earlier finish time on Saturdays and no work on Sundays. Construction hours are most often established to minimise amenity impacts on neighbouring residential areas, and will require finalisation further to consultation with Council.

3 Conclusions

Following a detailed assessment of the access, traffic and parking conditions associated with the Proposal, ARC has concluded that the Proposal would have no significant impacts on the local or on-site traffic environments. In summary: -

- The Proposal will not generate an additional level of operational traffic to the local traffic network.
- The Proposal will not result in additional rail movements or train crossings of longer duration at the Bolong Road rail crossing.
- Construction vehicle trips would be generated over a short period, and minimises through the provision of group transport for staff.
- The construction trip generation would have no significant impact on the operation of local intersections of access points to the Site.
- Construction staff parking will be provided adjacent to the construction area.
- An appropriate set of construction traffic management strategies will be put in place through the construction period.

ANNEXURE 9

Geotechnical Assessment
(Riverbank Stability)

prepared by

Coffey Geotechnics

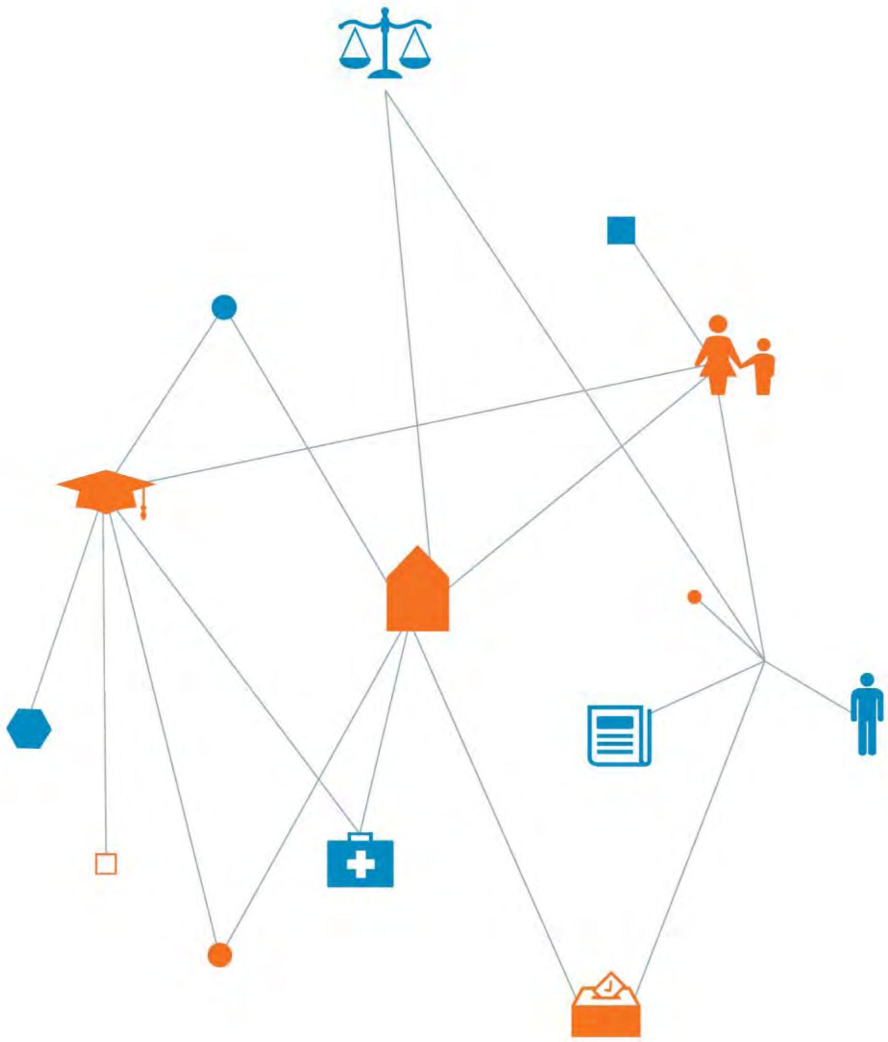
ANNEXURE 9

Manildra Group C/- Cowman Stoddart Pty Ltd

Modifications to Existing Flour Mill

Geotechnical Assessment

30 October 2015



Developing
solutions to
reduce poverty
and improve lives

Modifications to Existing Flour Mill

Prepared for
Manildra Group C/- Cowman Stoddart Pty Ltd
PO Box 738
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Attention: Stephen Richardson

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30 October 2015

Document authorisation

Our ref: GEOTWOLL03658AF-AA

Dear Stephen,

Please find enclosed our report on a geotechnical assessment in relation to Manildra's proposed Flour Mill Modifications in Bolong Road, Bomaderry NSW.

We draw your attention to the document following the report text entitled 'Important Information about Your Coffey Report" which should be read in conjunction with this report. Should you have any questions in relation to this report please contact the undersigned in our Wollongong office.

For and on behalf of Coffey

Dominic Trani
Senior Geotechnical Engineer

Quality information

Revision history

Revision	Description	Date	Author	Reviewer	Signatory
00	Final	30/10/2015	Dominic Trani	Jon Thompson	Dominic Trani

Distribution

Report Status	No. of copies	Format	Distributed to	Date
Final	00	PDF	Stephen Richardson (Cowman Stoddart Pty Ltd), Mark Manion (ME Engineering)	30/10/2015

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1. Introduction

Manildra Group (Manildra) is seeking an approval in relation to modifications to the existing flour mill located at Bomaderry plant to increase the amount of flour that can be produced on the site. The proposal involves installation of additional plant within the confines of the existing flour mill structure with only a minor addition external to the existing flour mill structure footprint. We understand that one of the key issues arising from the modification proposal is the Shoalhaven river bank stability, and a geotechnical assessment is required to address this issue.

We understand that the objectives of the geotechnical assessment are as follows:

- The potential effects of the flour mill modification on the stability of the river bank; and
- The potential effects of river bank movement on the stability of the flour mill foundation taking into account the additional loads applied to the ground by the new plant.

2. Scope of work

To address the above objectives, the following scope of work had been completed:

- Site visit by a Coffey geotechnical engineer on 30 September 2015 to visually assess the condition of the river bank at the proximity of the existing flour mill;
- Numerical modelling to assess the following:
  - Potential impact of the proposed additional loads applied on the flour mill structure and screw pile footing system to the river bank stability; and
  - Impact of the potential river bank failure/movement to the stability of the flour mill structure and screw pile foundation.
- Provide a geotechnical report summarising the outcome of our assessment and recommendations.

Information required to carry out the assessment had been provided by M.E. Engineering (on behalf of Manildra). Coffey has carried out a similar assessment for the new silos (already being constructed) to the east of the existing flour mill.

3. Site description

The flour mill structure is situated towards the southern and western side of the Shoalhaven Starches plant, near the northern bank of the Shoalhaven River (Figure 1). The ground surface over this location is relatively flat and the area surrounding the building is mainly covered by a concrete slab. The site is adjacent to the existing silos and other structures.

The Shoalhaven Starches plant is bounded by Bolong Road to the north and the Shoalhaven River to the south. The plant adjoins rural land to the north-east of Bolong Road, and industrial and commercial land use to the northwest.

3.1. Local geology and hydrogeology

Reference to the 1:100,000 Kiama Soil Landscape Series Sheet (9028, First Edition), produced by the Department of Conservation and Land Management NSW (1993) indicates that the site is located on Shoalhaven Soils. These soils are described as moderately deep prairie soils on levees, red earths and yellow and red podzolic soils on terraces and alluvial soils and gleyed podzolic soils on the floodplains.

Reference to the 1:250,000 Wollongong Geological Series Sheet (S1 56-9, First Edition) prepared by the NSW Department of Mines (1952) indicates the site is likely to be underlain by Quaternary alluvium, gravel, swamp deposits and sand dunes.

Based on observations made of the site, surrounding topography, and proximity of the nearby Shoalhaven River, groundwater is expected to be located at a depth of about 3m to 4m and flow to the south towards the river.

3.2. Inferred geotechnical model and groundwater

The general subsurface conditions and the inferred geotechnical model used in this assessment have been based on the model as developed for the recently constructed new silos adjacent to the flour mill structure to the east (Coffey report GEOTWOLL03658AA-AA dated 6 August 2014). A summary of the assumed subsurface conditions beneath the new silos is provided in Table 1. In the absence of borehole information within the flour mill structure footprint, it has been assumed that the information as presented in Table is applicable to the flour mill area. Furthermore, based on this report, groundwater inflows were encountered in the drilled boreholes at depths of 2.6m and 2.7m below existing ground surface level at the time of investigation.

Table 1 – Summary of assumed subsurface conditions beneath the new silos.

Geotechnical Unit	Description	Depth to top of unit below current ground level(1) (m)	Unit thickness(1) (m)	Consistency / relative density
Fill	Concrete Slab	0.0	0.15 and 0.35	-
Fill	Silty SAND / Sandy SILT: dark brown, fine to medium grained sand with trace of clay	0.15 and 1.50	1.0 and 1.55	Loose / Soft
	Clayey GLASS: Angular glass fragments, mixed with high plasticity clay, dark brown, trace of sand	0.35	1.15	Loose
Alluvial Soils	Clayey SILT: Dark brown, fine to medium grained sand, trace of clay	1.70	2.0	Very soft
Estuarine Soils	Silty Clay: Medium plasticity, dark grey / dark brown / orange, trace of shells and fine to medium grained sand	2.5 and 3.7	11.8 and 12.0	Very Soft
Residual Soil/ Extremely Weathered Rock	Clayey SAND: Fine to coarse grained sand, high plasticity clay, pale brown / pale grey	14.5 and 15.5	1.8 and 2.95	Loose to Dense
Highly Weathered to Slightly Weathered Sandstone	SANDSTONE: Fine to medium grained, pale grey / grey / orange, low to high strength with some inter-laminated fine to medium grained gravel	16.3 and 18.45	More than 4	-

Note: (1) The depths and thicknesses of the various units are based on a limited number of boreholes and may not represent the maximum or minimum values across the site or all materials beneath the site.

Table 2 below presents the inferred geotechnical parameters for the design of non-displacement piles developed for the new silos. In the absence of geotechnical information in relation to the design of the screw pile foundation system supporting the flour mill structure, it has been assumed that the below parameters are applicable to the assessment as per the scope of the present commission

Table 2 – Estimated non-displacement pile design parameters

Geotechnical Unit	Ultimate end bearing capacity[1] (MPa)	Ultimate shaft friction (kPa)	Ultimate lateral pressure (MPa)	Vertical Young's modulus (MPa)
Residual soils / Extremely weathered sandstone	-	60	0.7	50
Highly weathered sandstone (Class V sandstone)[2]	3.0	100	1.0	75
Sandstone (Class IV sandstone)[2]	9.0	350	3.5	250

Notes: [1]End bearing parameters would also apply to fully cased bored piles; however, shaft friction values do not apply; [2]Based on Pells et al, "Foundations on Shale and Sandstone in the Sydney Region", Australian Geomechanics Society, December, 1998.

4. Discussion and recommendations

4.1. Existing flour mill foundation system and the proposed modifications

As requested by Manildra, a review of the existing foundation system supporting the flour mill structure had been undertaken by ATB Consulting Engineers. A comparison between the existing foundation loads and the additional loads induced by the proposed flour mill modifications had also been assessed. Based on the above review and comparison, it has been confirmed by ATB Consulting Engineers that the existing flour mill structure screw pile foundation is adequate to support the additional loads imposed by the proposed structural modifications.

As per ATB Consulting Engineers review, the following assumptions have been made

1. Locations of the installed screw piles are as shown in the ATB Engineers Project Number 8048 Drawing Number S1 Revision F (dated 20 August 2008);
2. It is understood that each screw pile had been designed for a maximum load of 500kN. On the advice of ATB Consulting Engineers, it is assumed that the existing loads and the additional loads imposed by the proposed structural modifications are within the 500kN design limit;
3. Based on our discussion with EFA Piling (understood to have undertaken the screw pile installation supporting the flour mill structure), the screw piles had been installed to depths where socketing to highly weathered sandstone had been achieved. The screw pile installation logs that would show the achieved installation torques and depths are not available;
4. As per the advice of ATB Consulting Engineers, the design loads are distributed to the piles.

4.2. River bank stability assessment

4.2.1. Discussion

A preliminary assessment of the river bank stability had been presented in Coffey report GEOTWOLL03658AA-AA. The flour mill structure is located near (within 10m) of the section of river bank that is lined with the rock revetment wall (Figure 1), therefore Coffey requested that an updated round of survey monitoring of the revetment wall be carried out. The survey of the rock revetment was subsequently carried out by Allen Price and Scarratts on 28 September 2015. The monitoring data was obtained from 10 fixed survey markers embedded on 2 October 2008 in the revetment boulders. This data was then sent to Coffey for assessment as provided below.

Following the round of survey monitoring, Coffey has analysed and assessed settlement and/or lateral movement of the rock revetment wall along the river bank. As advised by the Surveyor, readings taken on 7 January 2009 were used as reference data. Enclosed Figures 2a to 2f show the approximate layout of the survey markers and monitoring plots between 7 January 2009 and 28 September 2015.

- The total recorded vertical movements during the monitoring period ranged from (+) 11mm (ie, upwards) to (-) 34mm (ie, downwards). The estimated rates of vertical movements range from (+) 1.65mm/yr to (-) 5.1mm/yr;
- The total recorded lateral movements perpendicular to revetment wall ranged from (-) 37mm (ie, towards the river) to (+) 17mm (ie, away from the river). The estimated rates of lateral movements range from (-) 5.5mm/yr to (+) 2.5mm/yr;
- No cross sections of the river bank have been provided at this stage; and
- Based on the survey monitoring data and the visual observations made during the site walkover on 30 September 2015, the generally downward movement at the top of the revetment wall (as indicated by the N pins) and upward movement at the toe of the revetment wall (as indicated by the S pins) is consistent with creeping rotational ground movement. At this stage, the total movements and rates of movements as indicated above could be attributed to a number of factors including the following:
  - Due to the recent flood event:
    - there has potentially been some change in the river bed profile;
    - there has potentially been some loss of fines behind the revetment wall and short term softening of the materials behind the revetment wall above the normal high tide level that were exposed to the flood waters ;
    - there has potentially been some heaving of the wall driven by the expansion of moisture sensitive soils behind the revetment wall;
  - Ground vibrations and movement due to soil displacement induced by pile driving activities during the construction of the new silos; and
  - The accuracy for the survey as advised by the Surveyor is +/- 5mm.

4.2.2. Recommendations

In relation to the river bank stability, we recommend the following actions to be taken:

1. The performance of the revetment wall and the condition of the river bed beyond the toe of the revetment wall will need to be monitored on a regular basis. Conduct regular survey monitoring of the revetment wall every 3 months to assess whether there is an ongoing pattern of movement over the next 12 months. If movement is insignificant during this time monitoring could then be reduced to once per year or after significant rainfall events that result in river levels rising more than 1m above the high tide level. Survey data for the river bed to a distance of 15m off the toe of the wall should also be carried out during the wall monitoring to check for changes in the bed profile;
2. Conduct regular visual observations to assess any obvious change to ground features in the surrounding area. The effects of major rain events, flooding or any significant deepening or steepening of the river bed close to the revetment wall will need to be assessed; and
3. Regular reviews of the survey data should be undertaken, and ongoing maintenance of the revetment wall or repairs where required.

4.3. Impact on flour mill structure pile foundation due to potential river bank movements

As the revetment wall overlies deep alluvial soils, changes to the river bed profile and erosion along the toe of the revetment wall in the future could result in movement of the wall and subsequently the bank between the revetment wall and the location of the flour mill structure.

The geotechnical model adopted to assess the impact of potential river bank movement on piled footings supporting the flour mill structure is drawn from Table 1and Table 2 presented above.

To assess the impact on the flour mill structure pile foundation due to potential river bank movements, the following steps have been followed:

- STEP 1: Estimate cumulative movement over a period of 20 years as extrapolated from surveyed incremental movements of the revetment wall;
- STEP 2: Apply the estimated cumulative movement as per STEP 1 as prescribed displacement at the revetment wall in a finite element analysis (PLAXIS 2D version AE) simulation to estimate the induced vertical and horizontal subsoil movements approximately 10m north from the top of the revetment wall. Output presented in Figure 3; and
- STEP 3: Assess likely settlement, pile axial load due to vertical soil movement, and axial and lateral responses of the piles due to lateral soil movement. Coffey in-house computer programmes PIES and ERCAP were used for pile deformation analyses under vertical and horizontal soil movements, respectively.

The assumed pile type and dimensions, properties and boundary conditions for this analysis are as follows:

- Pile type = shaft reinforced and grouted screw pile;
- Screw pile helix diameter = not available;
- Screw pile shaft thickness = 9mm;
- Screw pile shaft diameter = 193mm;
- Pile Young's modulus = 20,000 MPa (long term);
- Pile head boundary condition = free head;
- Pile tip boundary condition = fixed tip; and
- Pile head restraint condition = zero translation restraint.

The estimated pile deformations and structural actions as induced by the potential ground movements are summarised as follows:

- Likely additional axial load = 0.06MN;
- Likely additional bending moment = 0.002MNm;
- Likely additional shear force = 0.002MN
- Likely pile head movement (vertical) = 12mm;
- Likely pile head movement (horizontal) = 10mm; and
- Likely pile head rotation = 0.0026 radians.

The above analysis shows that the effects of the modelled river bank movements on the flour mill structure following modifications will be negligible and not affect its structural integrity.

4.4. Impact on river bank stability due to additional pile foundation loads

The additional structural vertical loads have been assessed by Recaf Design. It is understood from Recaf Design that the vertical loads had been assessed on a grid system where foundation design elements are understood to carry the loads. Excluding the wall panel loads, it is also understood that the additional loads due to the proposed modifications would represent a load increase ranging from less than 1% to as high as 7.3%. Including the wall panel loads, and as assessed by ATB Consulting Engineers, the total foundation load would be considered to be within the design capacity of 500kN per individual screw pile.

Based on the assumptions presented in Section 4.1 above, it is likely that the loads induced by the proposed modifications will be transferred to the piles founded in highly weathered sandstone. Assuming that each of the screw piles remain aligned with its main axis, the potential corrosion due to adversely aggressive environment does not compromise the required structural pile thicknesses, and the screw piles are adequately socketed into the highly weathered sandstone, ground deformation due to the proposed additional loads is considered to be minimal and its impact on the river bank stability would be insignificant.

5. Conclusion

The above report summarising our assessment and advice is based on our visual assessment of the area and review of available information including that provided by other parties. As the Manildra plant is located next to Shoalhaven River where there is some risk of flooding occurring, regular monitoring of the revetment wall and adjacent river bed, and the general condition of the river bank. Coffey should be advised of any obvious changes to ground features along the river bank, including the revetment wall.

We draw your attention to the document following the report entitled ‘Important Information about Your Coffey Report” which should be read in conjunction with this report.

Important information about your Coffey Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples.

These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures

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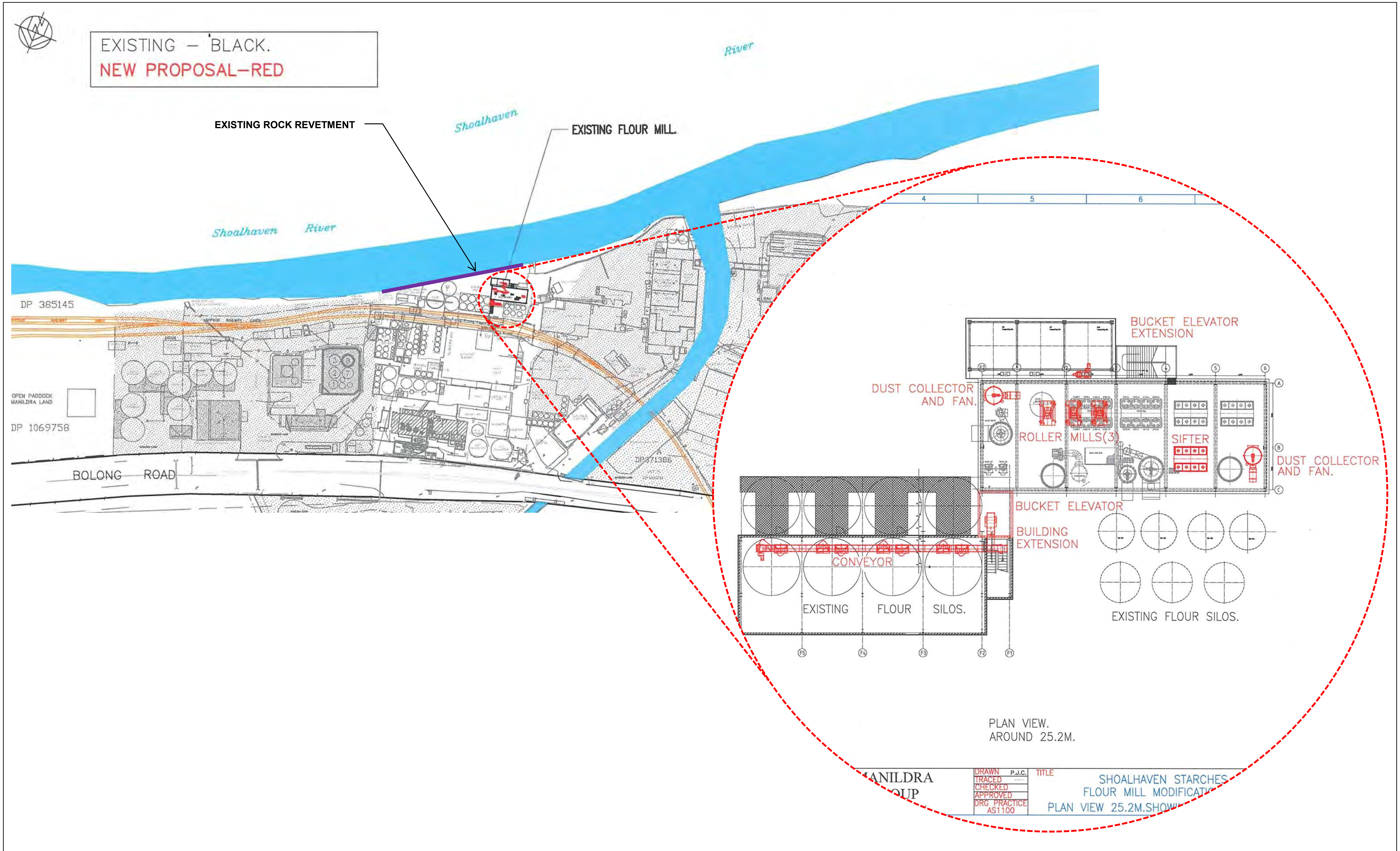


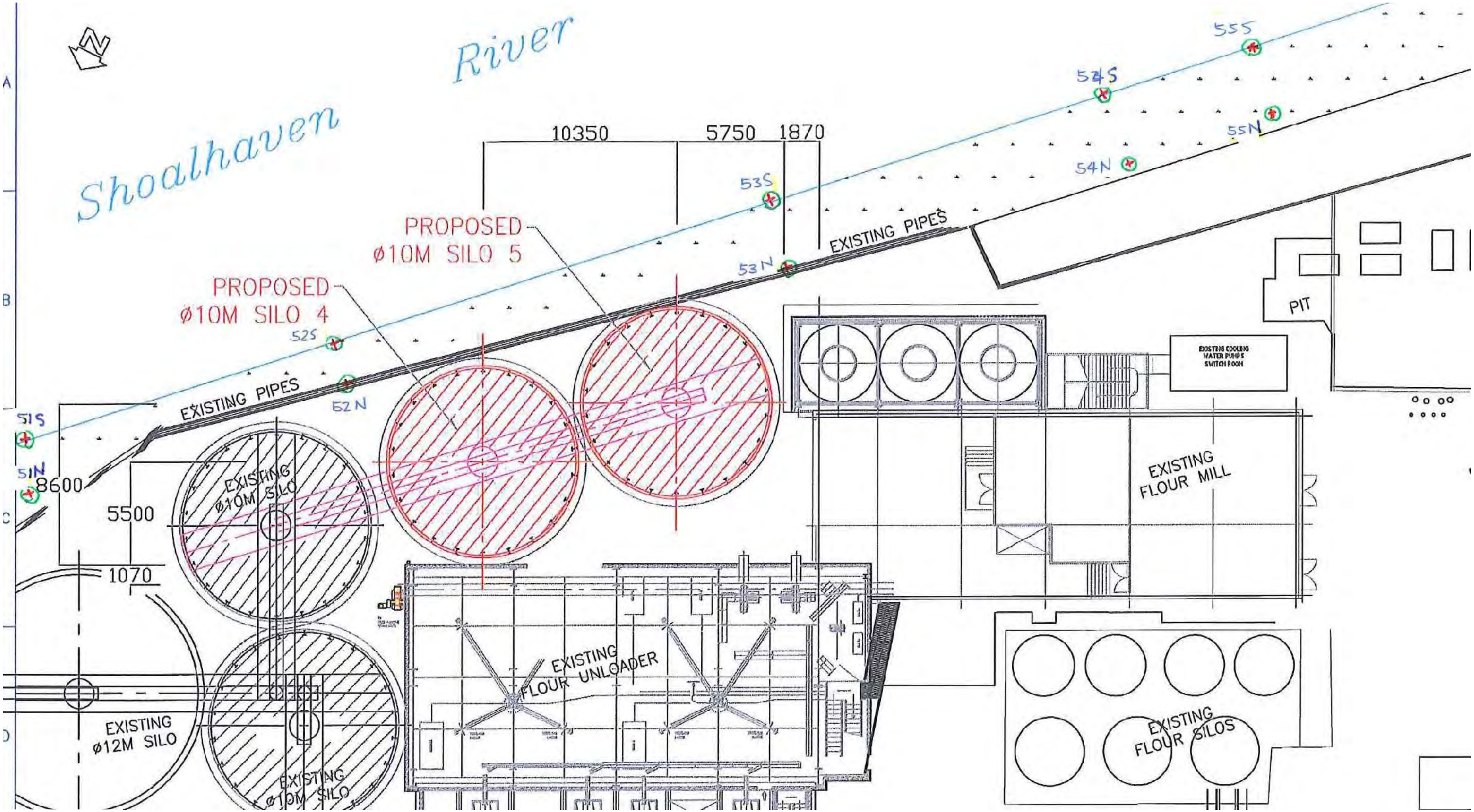
revision	description	drawn	approved	date
	General Location of Flour Mill Building	DT	JPT	27/10/2015

References:
1. General location plan as per Manildra – 5734 Drawing No.: MN257-005C;
2. Inset plan as per Manildra – 5734 Drawing No.: MN257-004B

drawn	DT
approved	JPT
date	21/07/2014
scale	N.T. S.
original size	A3

coffey

client:	Manildra Group Pty Ltd
project:	Modification to Existing Flour Mill Geotechnical Assessment Manildra, Bomaderry, NSW
title:	General Location of Flour Mill Building
project no:GEOTWOLL03658AF-AA	figure no: 1



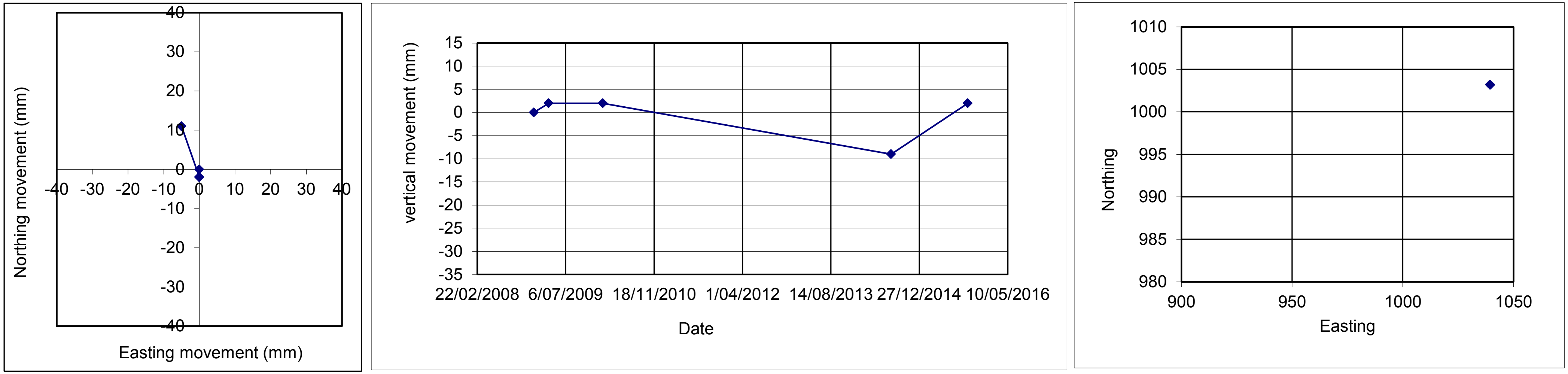
LEGEND:

Approximate location of monitoring points

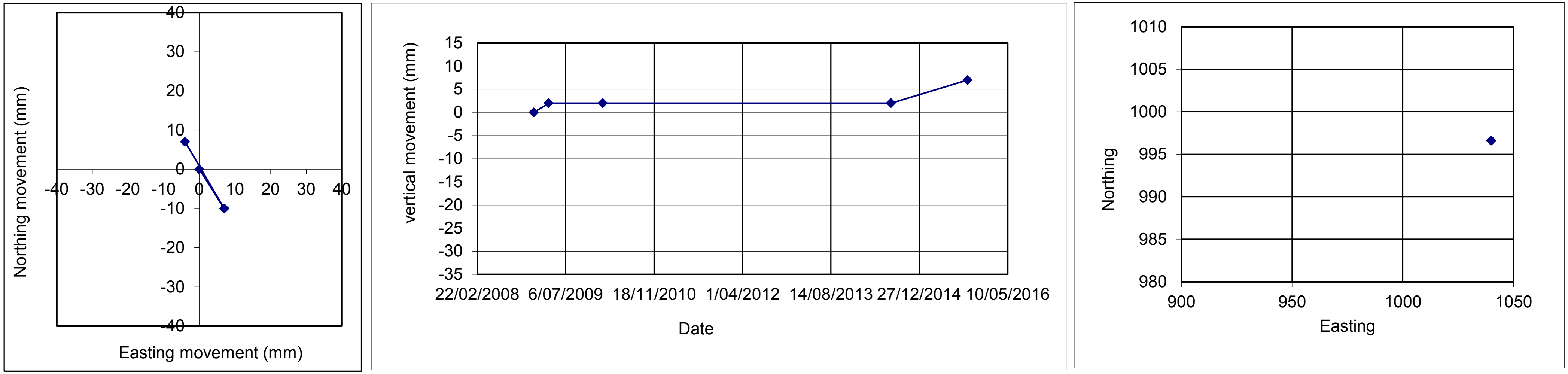
REFERENCE:
Manildra Group, Nowra – Proposed Silo #4 & #5
Layout Plan, Drawing No. MN231-001, Issue 5445
dated 23 May 2014

drawn	DT	coffey	client:	Manildra Group Pty Ltd
approved	JPT		project:	Modification to Existing Flour Mill Manildra, Bomaderry NSW
date	28/10/2015			
scale	NTS		title:	Monitoring Point Location Layout
original size	A4		project no: GEOTWOLL03658AF	figure no: 2a

Monitoring point 51N (refer to Figure 2a)

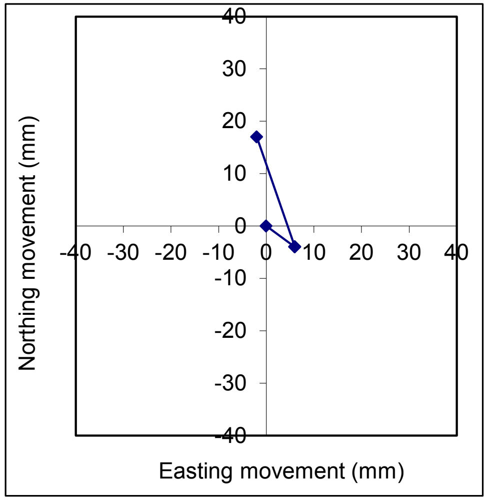


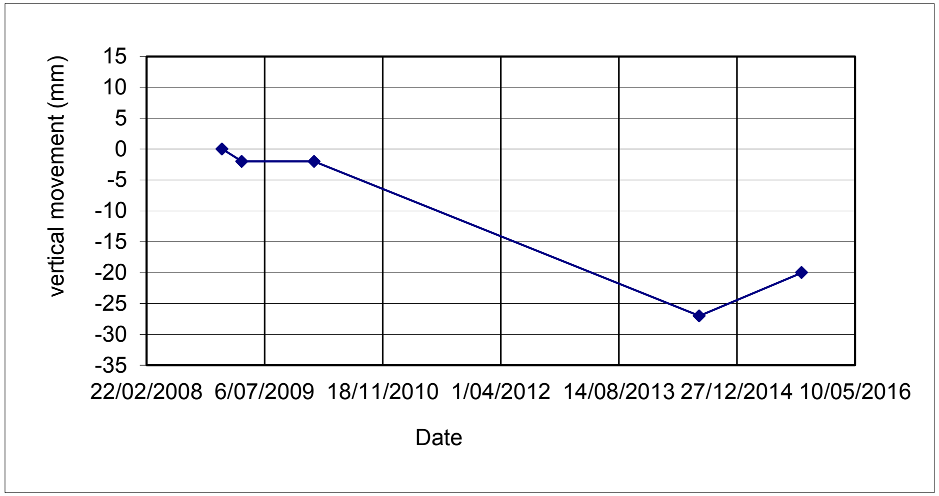
Monitoring point 51S (refer to Figure 2a)

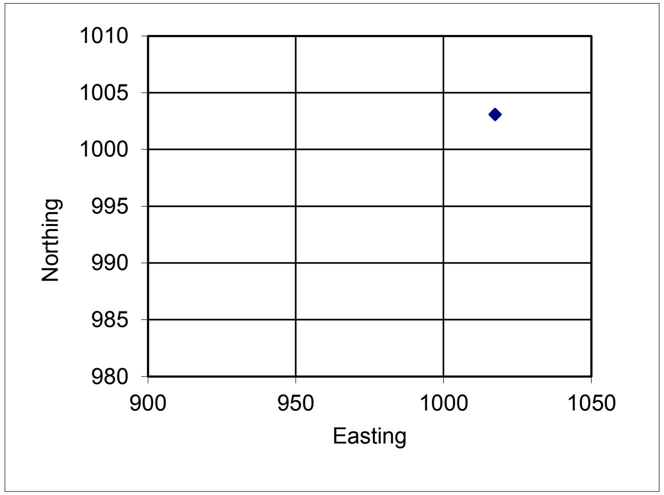


drawn	DT	coffey	client:	Manildra Group Pty Ltd	
approved	JPT		project:	Modification to Existing Flour Mill Manildra, Bomaderry NSW	
date	28/10/2015				
scale	NTS		title:	Monitoring Data	
original size	A4		project no: GEOTWOLL03658AF		figure no: 2b

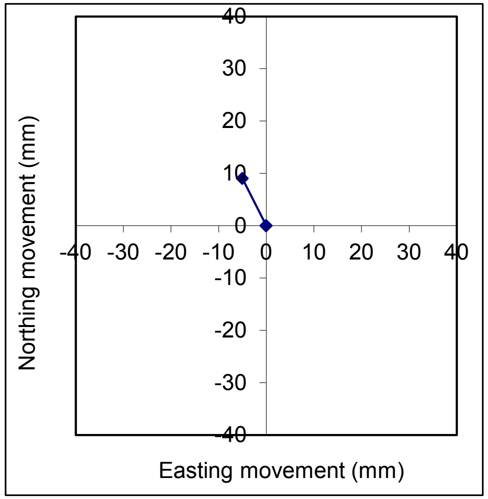
Monitoring point 52N (refer to Figure 2a)

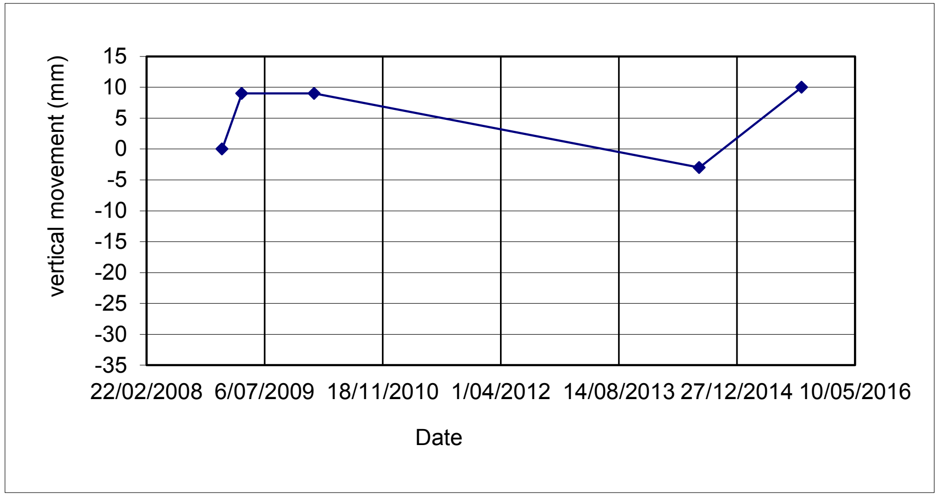


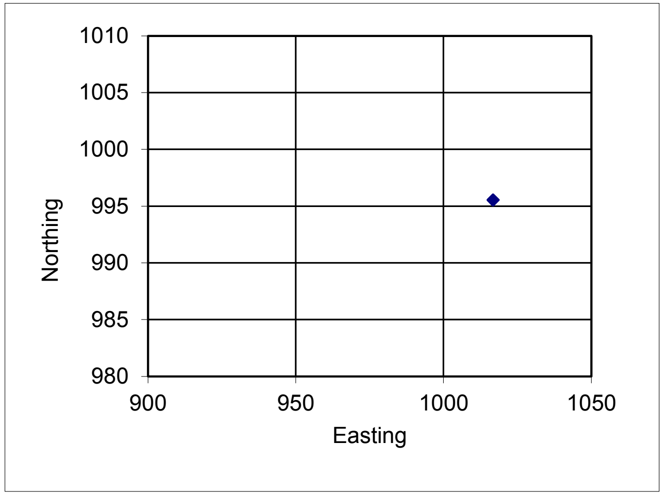




Monitoring point 52S (refer to Figure 2a)

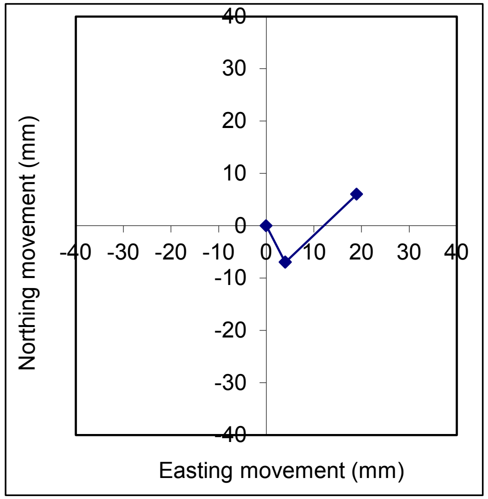


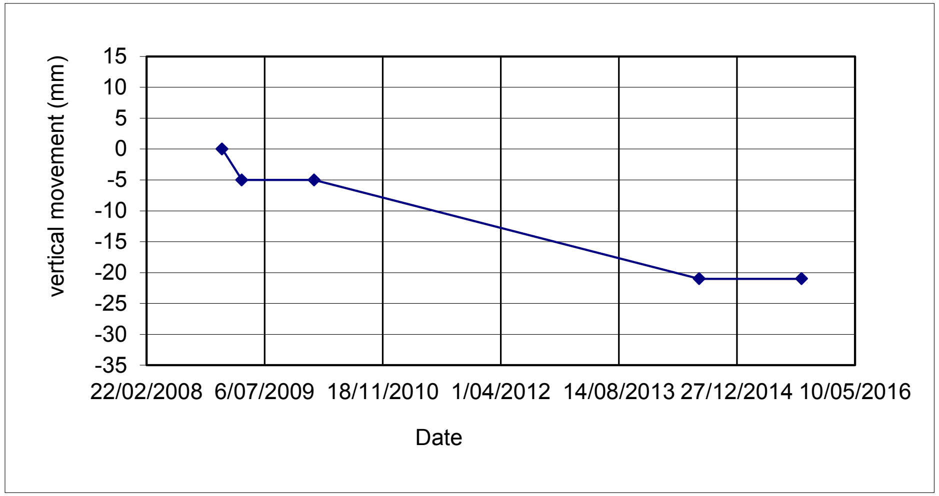


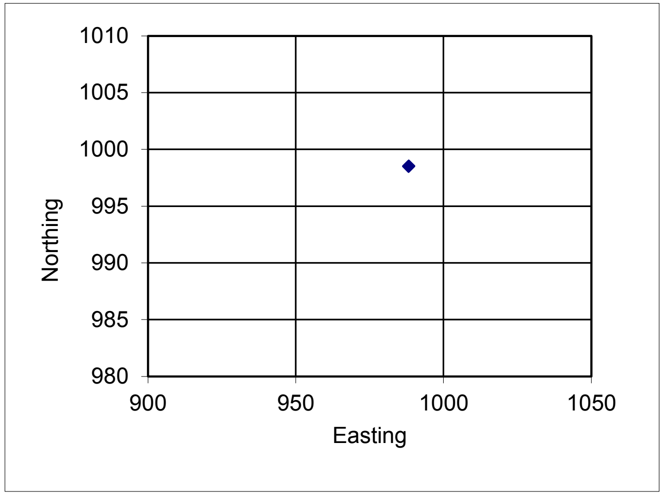


drawn	**DT**	coffey	client:	**Manildra Group Pty Ltd**
approved	**JPT**		project:	**Modification to Existing Flour Mill Manildra, Bomaderry NSW**
date	**28/10/2015**		title:	**Monitoring Data**
scale	**NTS**		project no: **GEOTWOLL03658AF**	figure no: **2c**
original size	**A4**			

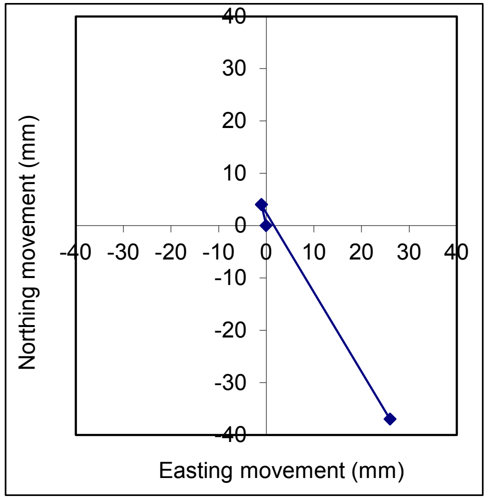
Monitoring point 53N (refer to Figure 2a)

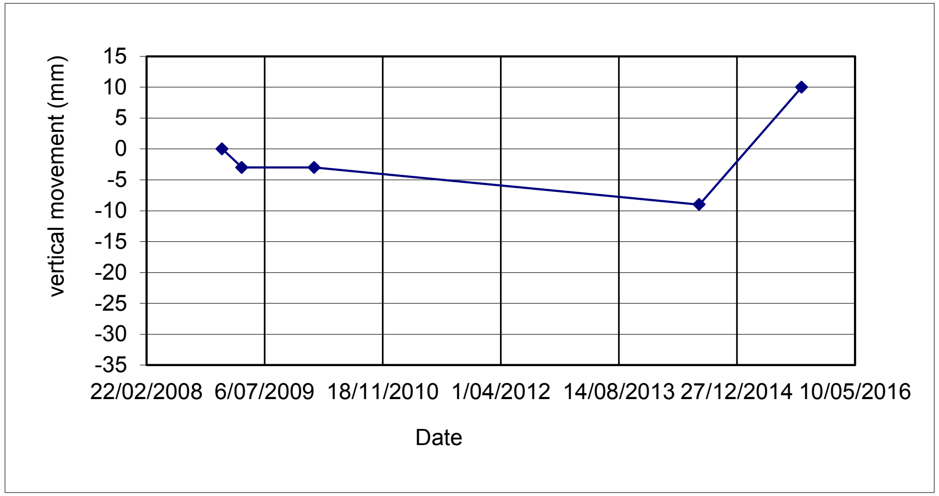


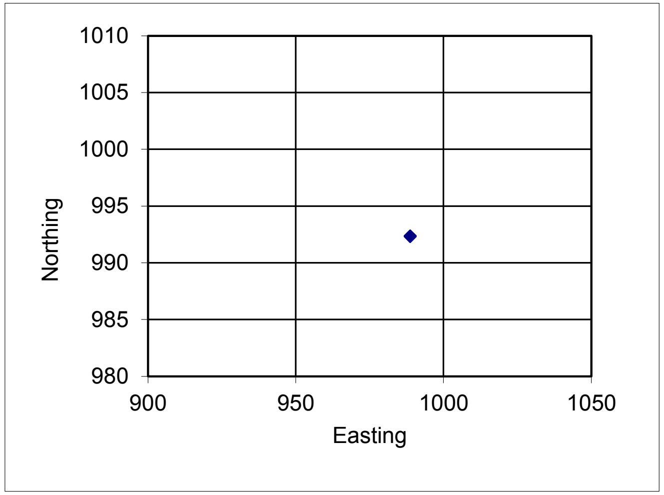




Monitoring point 53S (refer to Figure 2a)

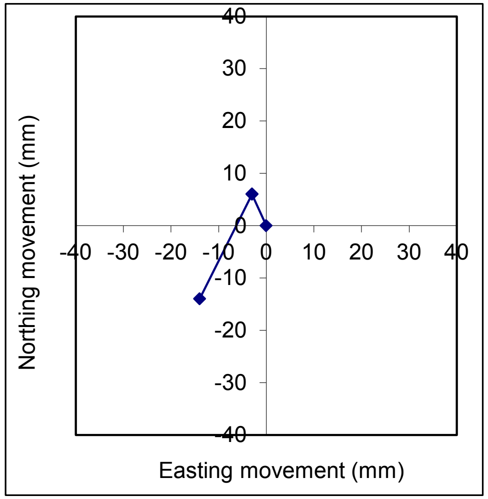


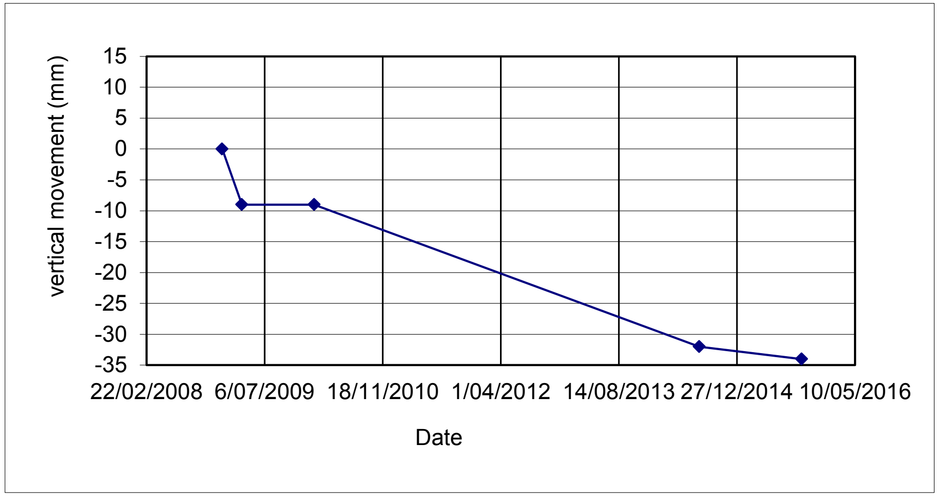


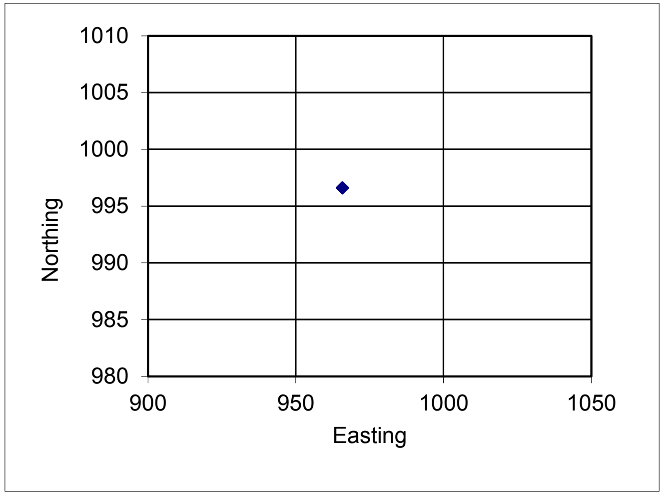


drawn	**DT**	client:	**Manildra Group Pty Ltd**
approved	**JPT**	project:	**Modification to Existing Flour Mill Manildra, Bomaderry NSW**
date	**28/10/2015**	title:	**Monitoring Data**
scale	**NTS**	project no: **GEOTWOLL03658AF**	figure no: **2d**
original size	**A4**		

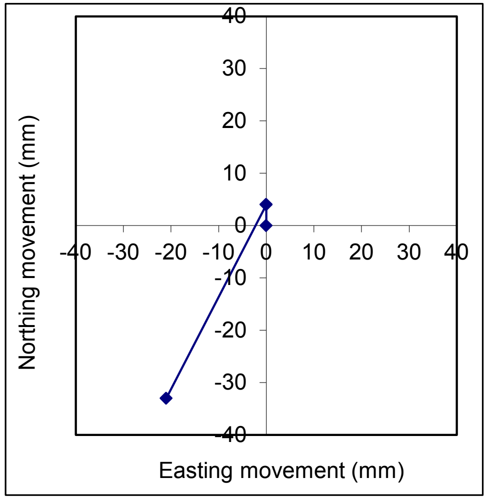
Monitoring point 54N (refer to Figure 2a)

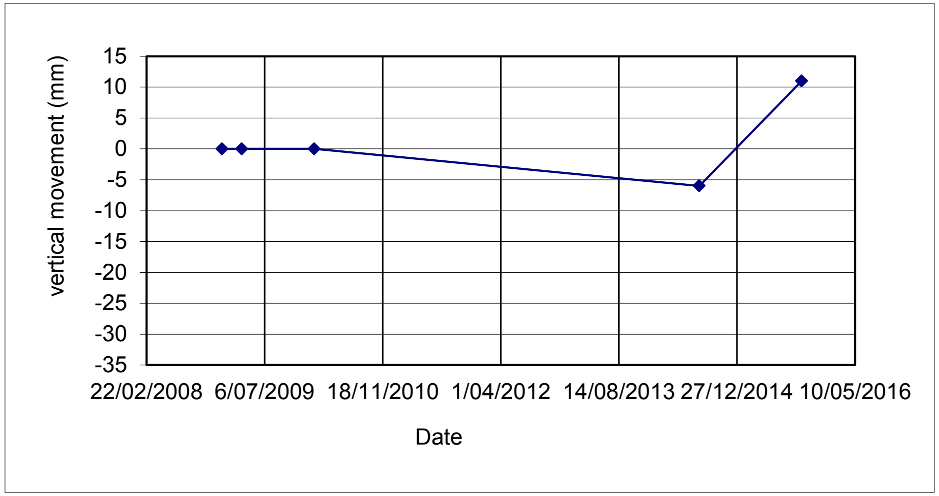


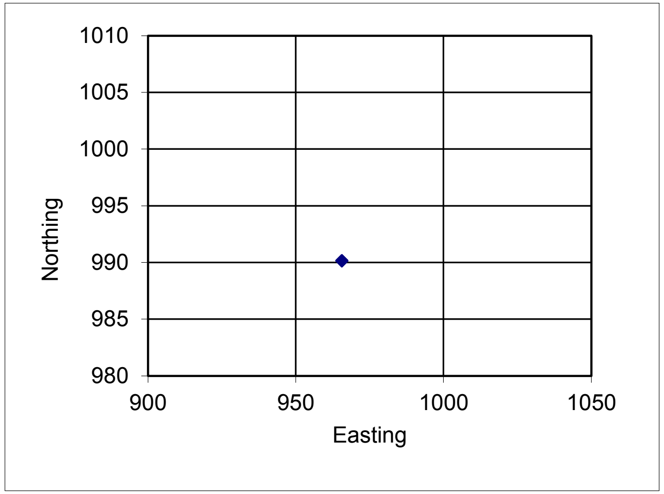




Monitoring point 54S (refer to Figure 2a)

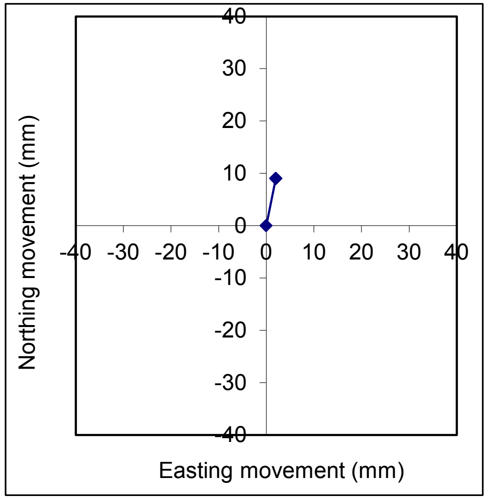


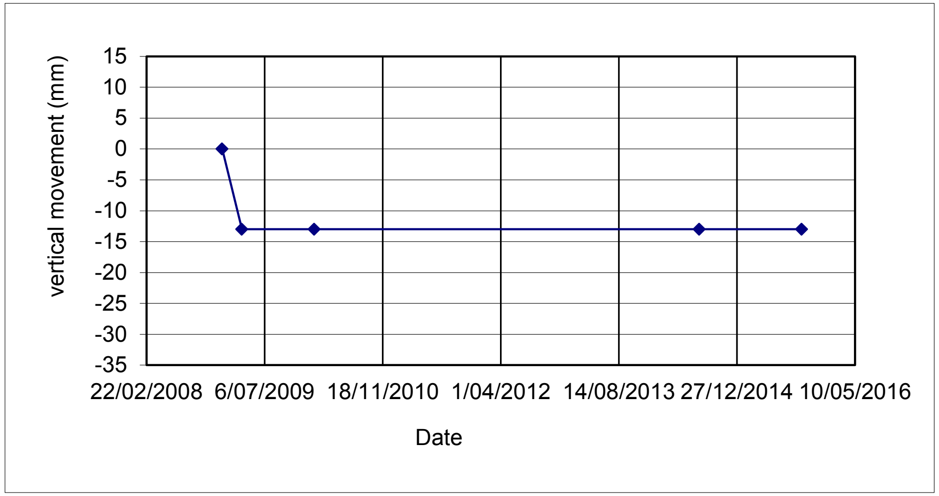


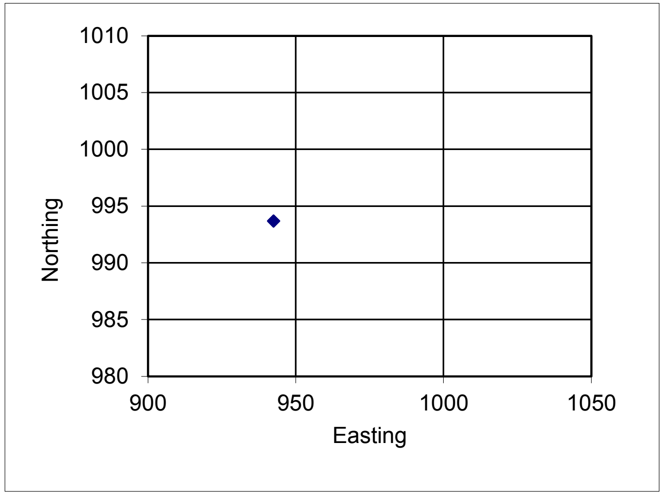


drawn	**DT**	coffey	client:	**Manildra Group Pty Ltd**
approved	**JPT**		project:	**Modification to Existing Flour Mill Manildra, Bomaderry NSW**
date	**28/10/2015**			
scale	**NTS**		title:	**Monitoring Data**
original size	**A4**		project no: **GEOTWOLL03658AF**	figure no: **2e**

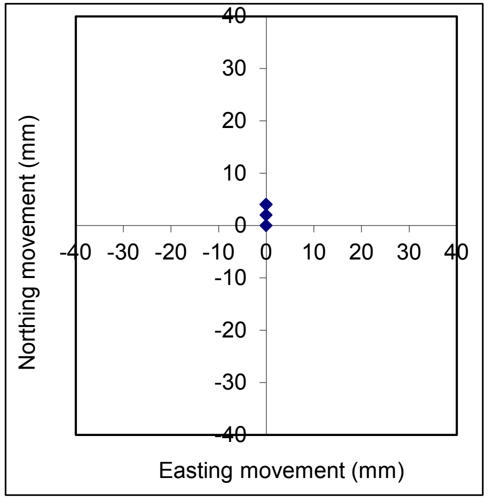
Monitoring point 55N (refer to Figure 2a) – *this monitoring point could not be located and the monitoring data presented since 2009 is dummy only*

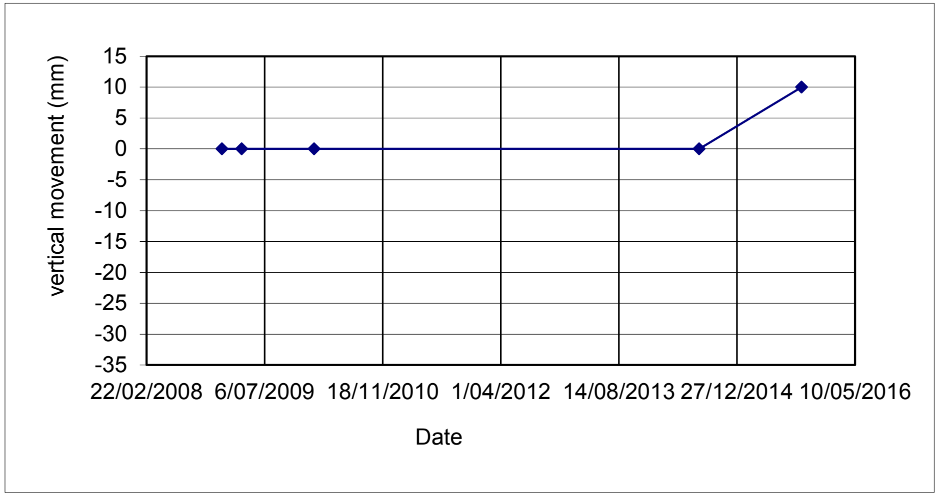


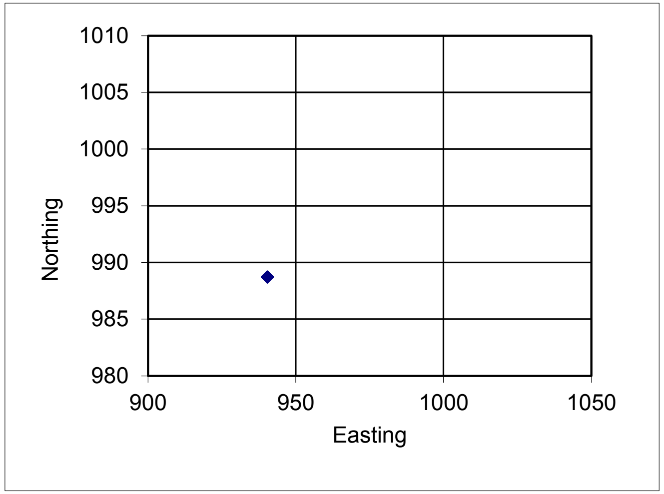




Monitoring point 55S (refer to Figure 2a)

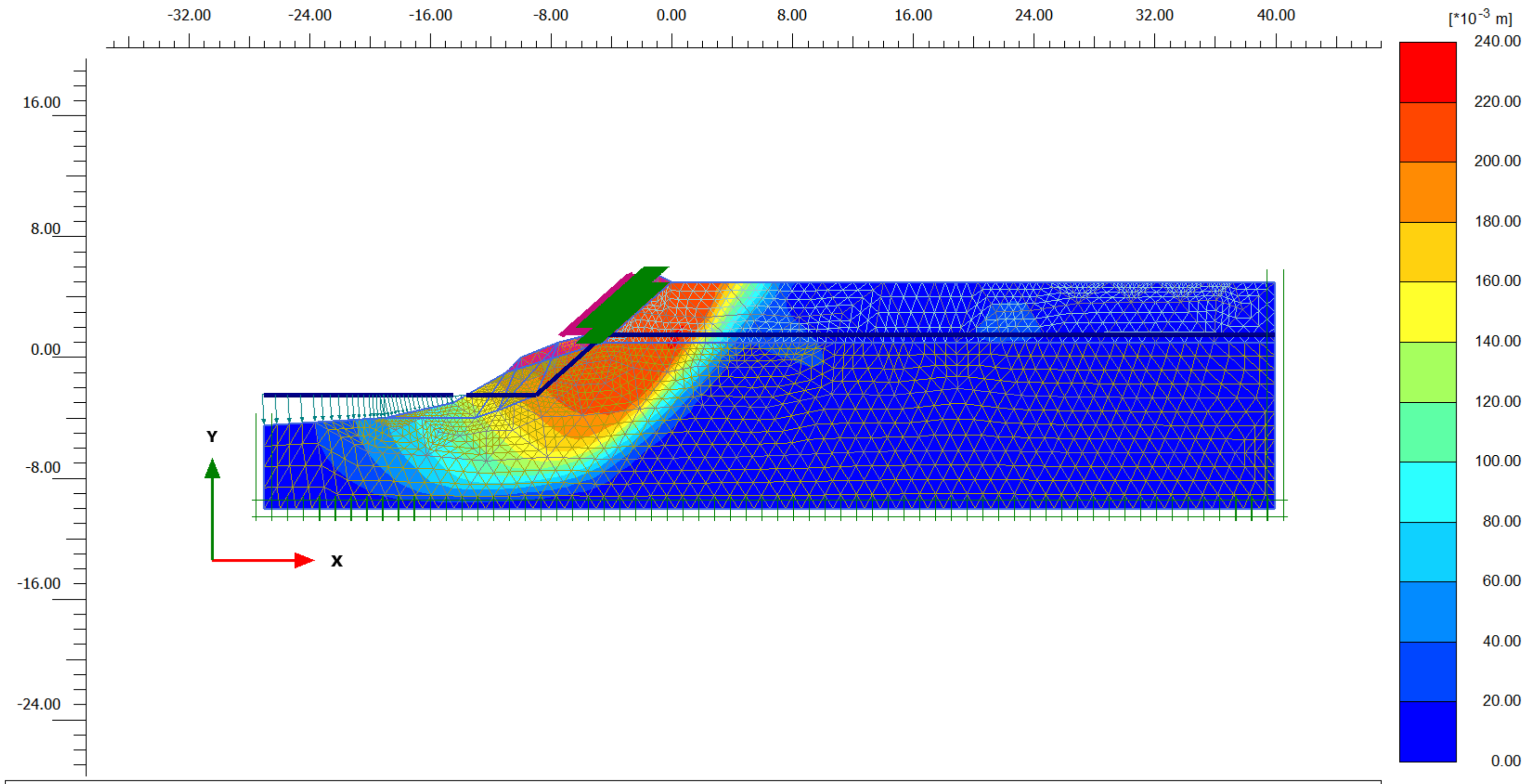






drawn	**DT**	client:	**Manildra Group Pty Ltd**
approved	**JPT**	project:	**Modification to Existing Flour Mill Manildra, Bomaderry NSW**
date	**28/10/2015**		
scale	**NTS**	title:	**Monitoring Data**
original size	**A4**	project no: **GEOTWOLL03658AF**	figure no: **2f**

Output Version 2013.2.16712.10959



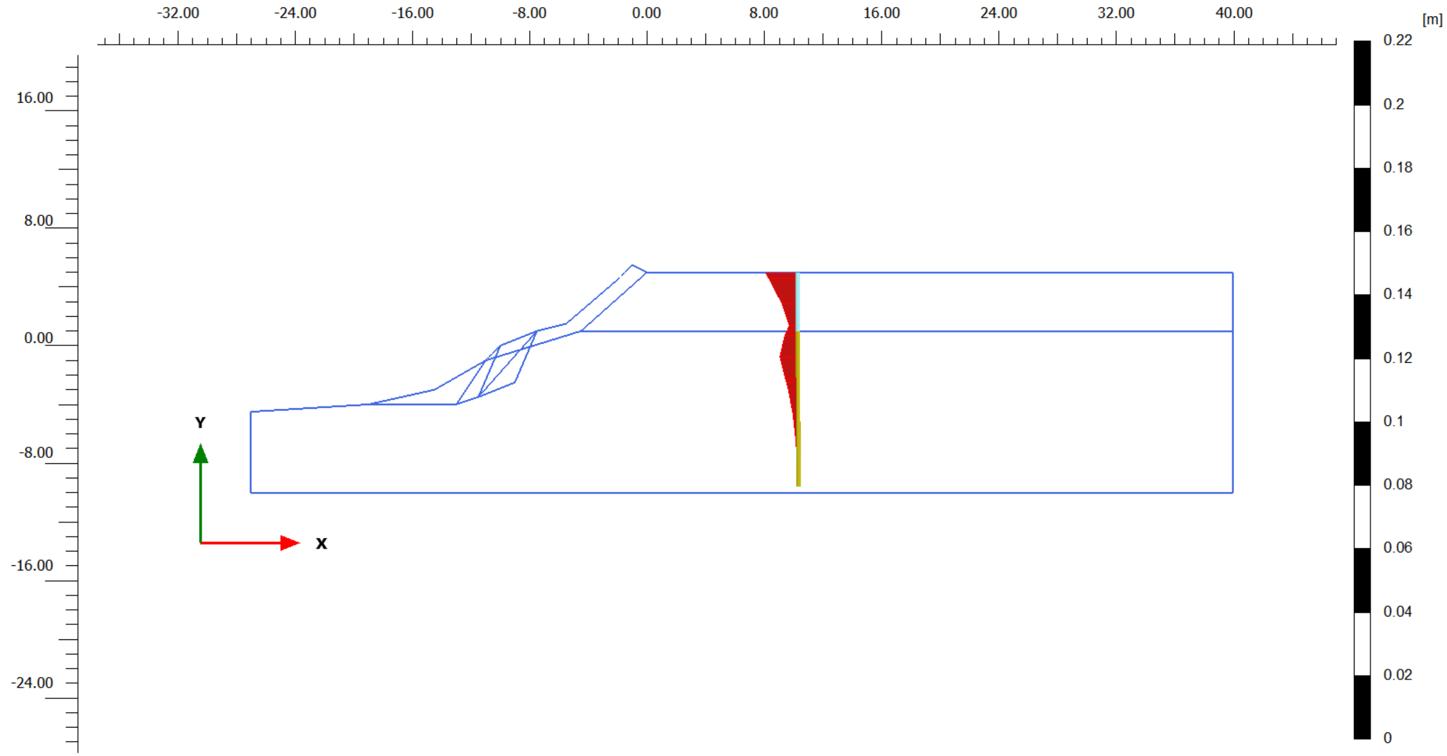
Total displacements |u|

Maximum value = 0.2206 m (Element 40 at Node 1871)

coffey	*Project description* Manildra - Flour Mill Modification		*Date* 29/10/2015
	Project filename Manildra - Flour Mill Modification	*Step* 241	*User name* Coffey Geosciences Pty Ltd

drawn	**DT**	coffey	client:	**Manildra Group Pty Ltd**
approved	**JPT**		project:	**Modification to Existing Flour Mill Manildra, Bomaderry NSW**
date	**29/10/2015**			
scale	**NTS**		title:	**PLAXIS – Deformed mesh of typical revetment cross section induced by prescribed revetment of 50mm towards the river**
original size	**A4**		project no: **GEOTWOLL03658AF**	figure no: **3a**

Output Version 2013.2.16712.10959



Total displacements u_x (scaled up 200 times)

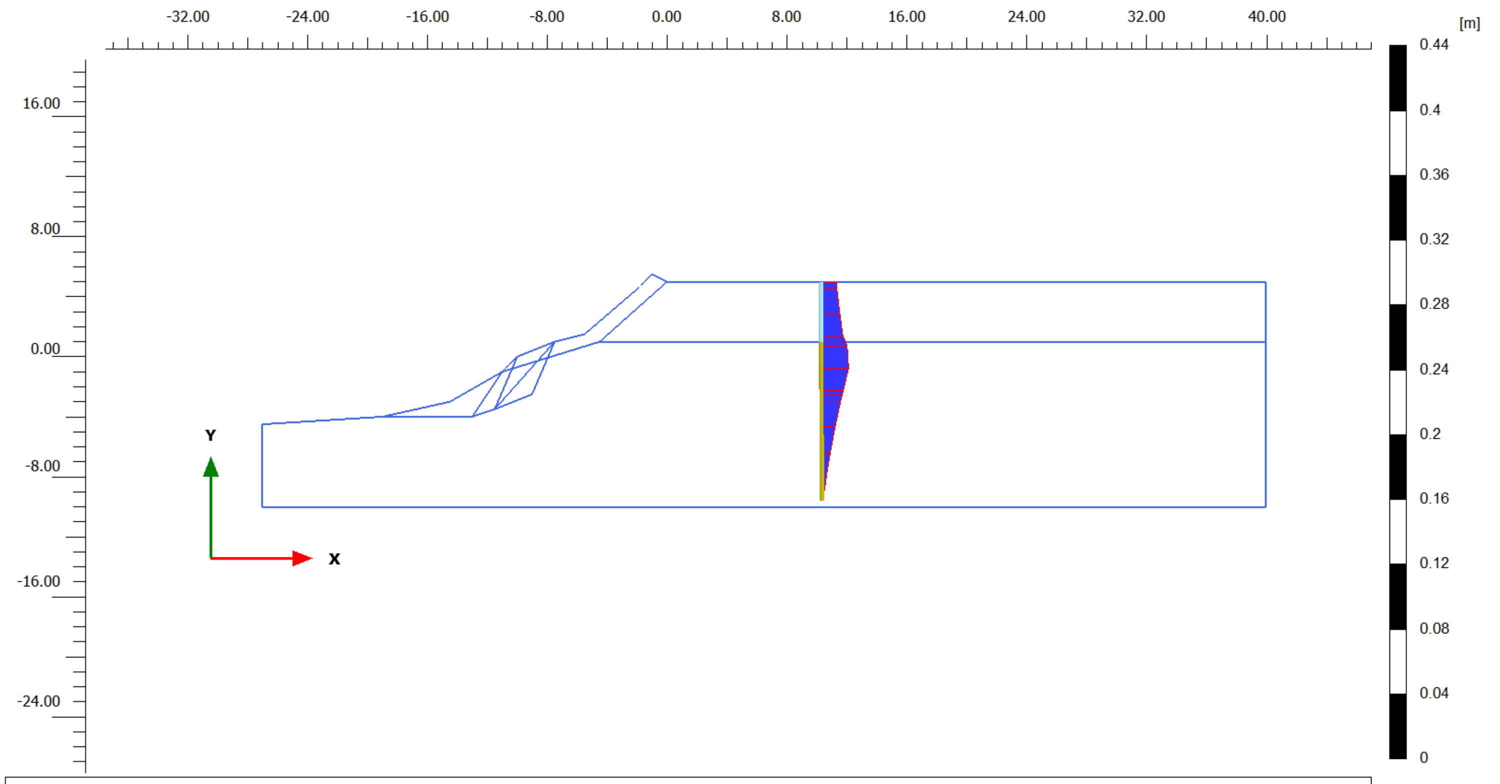
Maximum value = -0.05078×10^{-3} m

Minimum value = -0.01086 m

coffey	*Project description* Manildra - Flour Mill Modification		*Date* 29/10/2015
	Project filename Manildra - Flour Mill Modification	*Step* 241	*User name* Coffey Geosciences Pty Ltd

drawn	DT	coffey	client:	**Manildra Group Pty Ltd**
approved	JPT		project:	**Modification to Existing Flour Mill Manildra, Bomaderry NSW**
date	29/10/2015			
scale	NTS		title:	**PLAXIS – Estimated lateral movement approximately 10m away from revetment wall considering prescribed revetment movement of 50mm towards the river**
original size	A4		project no: **GEOTWOLL03658AF**	figure no: **3b**

Output Version 2013.2.16712.10959



Total displacements u_y (scaled up 100 times)

Maximum value = 0.01817 m

Minimum value = 0.6093×10^{-3} m

Project description	Date
Manildra - Flour Mill Modification	29/10/2015

Project filename	Step	User name
Manildra - Flour Mill Modification	241	Coffey Geosciences Pty Ltd

drawn	DT
approved	JPT
date	29/10/2015
scale	NTS
original size	A4

client:	**Manildra Group Pty Ltd**
project:	**Modification to Existing Flour Mill Manildra, Bomaderry NSW**
title:	**PLAXIS – Estimated lateral movement approximately 10m away from revetment wall considering prescribed revetment movement of 50mm towards the river**
project no: **GEOTWOLL03658AF**	figure no: **3c**